

NEW YORK CITY ZEBRA MUSSEL MONITORING ACT OF 1991

HEARING
BEFORE THE
SUBCOMMITTEE ON
WATER RESOURCES, TRANSPORTATION,
AND INFRASTRUCTURE
OF THE
COMMITTEE ON
ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE
ONE HUNDRED SECOND CONGRESS
FIRST SESSION

ON

S. 36

A BILL ENTITLED THE "NEW YORK CITY ZEBRA MUSSEL MONITORING
ACT OF 1991"

MAY 31, 1991—CATSKILL, NY

Printed for the use of the Committee on Environment and Public Works



U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1991

43-975 ±

For sale by the U.S. Government Printing Office
Superintendent of Documents, Congressional Sales Office, Washington, DC 20402
ISBN 0-16-035392-0

5321-35

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

QUENTIN N. BURDICK, North Dakota, *Chairman*

DANIEL PATRICK MOYNIHAN, New York	JOHN H. CHAFEE, Rhode Island
GEORGE J. MITCHELL, Maine	ALAN K. SIMPSON, Wyoming
MAX BAUCUS, Montana	STEVE SYMMS, Idaho
FRANK R. LAUTENBERG, New Jersey	DAVE DURENBERGER, Minnesota
HARRY REID, Nevada	JOHN W. WARNER, Virginia
BOB GRAHAM, Florida	JAMES M. JEFFORDS, Vermont
JOSEPH I. LIEBERMAN, Connecticut	ROBERT SMITH, New Hampshire
HOWARD M. METZENBAUM, Ohio	
HARRIS WOFFORD, Pennsylvania	

DAVID M. STRAUSS, *Staff Director*

STEVEN J. SHIMBERG, *Minority Staff Director and Chief Counsel*

SUBCOMMITTEE ON WATER RESOURCES, TRANSPORTATION, AND INFRASTRUCTURE

DANIEL PATRICK MOYNIHAN, New York, *Chairman*

GEORGE J. MITCHELL, Maine	STEVE SYMMS, Idaho
FRANK R. LAUTENBERG, New Jersey	JOHN W. WARNER, Virginia
HARRY REID, Nevada	JAMES M. JEFFORDS, Vermont
BOB GRAHAM, Florida	DAVE DURENBERGER, Minnesota
JOSEPH I. LIEBERMAN, Connecticut	ROBERT SMITH, New Hampshire
HOWARD M. METZENBAUM, Ohio	JOHN H. CHAFEE, Rhode Island

CONTENTS

OPENING STATEMENT

Moynihan, Hon. Daniel Patrick, U.S. Senator from the State of New York	Page 1
--	-----------

WITNESSES

Conway, Joseph P., Assistant Commissioner, Bureau of Water Supply, New York City Department of Environmental Protection	22
Prepared statement	45
Danielson, Colonel Ralph M., Commander and District Engineer, New York District, U.S. Army Corps of Engineers.....	17
Prepared statement	39
Kahabka, John, Senior Engineer, Nuclear Generation Department, New York Power Authority.....	11
McCord, William J., Village President, Catskill, NY.....	1
O'Neill, Charles R., Jr., Regional Extension Specialist, New York Sea Grant Extension Program	6
Prepared statement	33
Veith, Gilman D., Director, Environmental Research Laboratory, U.S. Environmental Protection Agency.....	3
Prepared statement	30

ADDITIONAL MATERIAL

S. 36	52
-------------	----

NEW YORK CITY ZEBRA MUSSEL MONITORING ACT OF 1991

FRIDAY, MAY 31, 1991

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON WATER RESOURCES,
TRANSPORTATION, AND INFRASTRUCTURE,
Catskill, NY.

The subcommittee met, pursuant to notice, at 10:30 a.m. in the Town Hall, Catskill, New York, Hon. Daniel Patrick Moynihan [chairman of the subcommittee] presiding.

Present: Senator Moynihan.

STATEMENT OF WILLIAM J. McCORD, VILLAGE PRESIDENT, CATSKILL, NY

Mr. McCORD. Fellow citizens of Catskill, I welcome you here to this hearing, and I in particular want to welcome Senator Moynihan here, who, as you all know, is our United States Senator from New York and who has a very distinguished record in Congress as our Ambassador to the United Nations, and he has written some very important reports that have made news in this country over the past 10 or 20 years.

On behalf of the village, I say welcome, Senator, and on a personal note, I want to tell you that my wife and I are both Vassar graduates, and I want to commend you for your forthrightness and your courage down there in that scene last year at Vassar. I took my hat off to you, and you did a darn good job, Senator. Thank you.

OPENING STATEMENT OF HON. DANIEL PATRICK MOYNIHAN, U.S. SENATOR FROM THE STATE OF NEW YORK

Senator MOYNIHAN. I want to thank you, sir, and thank the village for its courtesy in making the Town Hall available.

We have a simple purpose. This is a meeting of the Subcommittee on Water Resources, Transportation, and Infrastructure of the Committee on Environment and Public Works. We are here primarily for the purpose of making a record of what has most recently transpired in this area of the zebra mussel infestation, which began in about 1986.

The numbers, for those of you who aren't familiar, is that, as best anyone can reconstruct this event, the zebra mussel came over in ballasts in what could be any ship, but probably cleared Antwerp Harbor, which, having gotten cleaned up, as President McCord will know, you never change just one thing. They cleaned

up the water in Antwerp so the zebra mussel could thrive, took on ballasts there, discharged in Lake St. Claire, which is just off Michigan between Heron and Lake Michigan, we think five years ago. Three years ago, it was sighted and identified. One year ago, the subcommittee, which has jurisdiction, held hearings in the Great Lakes region. We held hearings at Alexandria Bay on the St. Lawrence, which is in the eastern region of the Great Lakes Basin, and then another at Dunkirk on Lake Erie, where the Niagara Mohawk Power Authority was beginning to deal with these things.

At the time, we were, I think, well-advised by the biologists who spoke with us and who said that the zebra mussel, *Dreissena polymorpha*, would make its way onto the surface waters of all of the United States in 20 years. There was no point in trying to quarantine it. It was here, and we just have to learn to live with it and control it. As we will hear, there are no natural predators except ducks, and if we could breed a species of ducks with necks that were 60 feet long, we probably would do well. But it comes under the heading of "life is one thing after another," and to be ready for this is to handle it better than you otherwise would.

When it was said that it would spread, the biologists' view was very simple: this little creature can live on anything, it can go without food for almost a year, just a little bit of water in a bait box will transport it from one water system to another. There aren't that many water systems in the United States. Once you're in Lake Erie, in no time at all you're going to be in the Erie Canal; once you're in the Erie Canal, you're in Catskill, New York. It just follows. Once you're in Lake Michigan, I think, as Colonel Danielson will tell us, the Great Lakes—Chicago has a flushing system which takes Great Lakes water and puts it into the Mississippi water basin, so it will be in New Orleans—it's there now. Just get that point settled, and you know what you're dealing with. What to do is another question.

After the hearings had been held in the last Congress, I introduced on behalf of the committee a bill called the Zebra Mussel Control Act of 1990, which we introduced on September 17, after our hearings in the Great Lakes Basin, and this was incorporated into H.R. 5390 with the kind of clumsy name of the Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990, but it did authorize \$25 million over five years in grants to States for the control of zebra mussels.

That measure the President signed in November. We responded fairly expeditiously. That was too late for an appropriation in that cycle, but the House has appropriated money already. They got their appropriation bill in this area done May 29—and we will get to the same, and we will start this.

On the first day of this Congress, I introduced S. 36, which is directly concerned with the Hudson River. It's the New York City Zebra Mussel Monitoring Act of 1991, and we'll pass this bill before this Congress is out. Unfortunately, before this bill is passed, we encountered the problem, as we're going to hear this morning from the people who know, and we're very privileged to have Commissioner Conway here from the Water Supply System.

Our concern was that we had already seen what zebra mussels can do to small cities and villages along the lakes, where they get

into the water system, and the next thing you know, as President McCord would be the first to tell you, water pressure drops, and the fire department says, "We can't guarantee what would happen if there's a fire in the hospital or a fire in the school," and the next thing you know, you've got yourself a real problem. That's happened to villages all across the lakes. What would happen in New York City is of a different order of magnitude simply because of the size of the problem.

We are new to this problem. Whatever else the committee knows, it knows one thing, which is that there are people who know a lot more about this subject than we do, and we're very grateful to those who have come here today from across the region.

First of all, we're going to have two panels, and may I say that our approach, from the committee's point of view, is appropriately jurisdictional. We have the great distinction of our association with the Corps of Engineers, and they have large responsibilities for water systems and water supply in our country, and we are very honored this morning that Colonel Danielson, who is the District Engineer, will be here, and with him, Dr. Miller, who has come all the way from Vicksburg.

But first we're going to have a panel of environmentalists, so if I could ask Dr. Gilman Veith if you'd come forward sir—good morning, Doctor—and Charles O'Neill, who is with the New York Sea Grant Extension Program—appropriately bearded, as is in the tradition of biologists—and Mr. John Kahabka, who is the Senior Engineer of the New York Power Authority. Good morning to you, sir.

If you have prepared statements, you may place them in the record, and then maybe you'll tell us about what you think we ought to know. I made the point that we're here to make a record that we can bring back to Washington and say, "This is what we're dealing with."

Dr. Veith, welcome all the way from Minnesota, and would you proceed, sir?

STATEMENT OF GILMAN D. VEITH, DIRECTOR, ENVIRONMENTAL RESEARCH LABORATORY, U.S. ENVIRONMENTAL PROTECTION AGENCY, DULUTH, MN

Mr. VEITH. Thank you.

Good morning, Mr. Chairman and members of the subcommittee. My name is Gilman Veith. I'm the Director of the U.S. EPA Environmental Research Laboratory in Duluth, Minnesota. I have provided a copy of my written statement, but I will offer a brief oral summary at this time.

Senator MOYNIHAN. Please don't be brief, sir. We didn't bring you from Duluth to hurry you up.

Mr. VEITH. I appreciate the opportunity to discuss the impacts of the zebra mussels on aquatic ecosystems and the potential to spread these organisms to systems providing water for New York City, and I am particularly enjoying the hospitality of the people of Catskill.

Zebra mussels are called aquatic nuisances whenever they show up in places they're not adapted to ecologically. They belong over

in the Caspian Sea area, not in the waters of New York. When they get here, they're considered nuisances.

EPA is an active participant on the Aquatic Nuisance Species Task Force formed by the Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990 that you mentioned in your opening comments. This task force is working to create a multi-agency program for monitoring the control and the study of zebra mussels in the U.S. waters. EPA shares the concern over the economic impacts on public water supplies as well as on the fisheries of the country. We believe that our role in this task force and in our research laboratories is to focus on the long term spread of this organism throughout the Nation and on the impact on the integrity of the biological communities in our lakes and streams.

To this end, I am responsible for developing a monitoring program which will include the zebra mussels in the Great Lakes and some of the other fresh waters of the country. The Duluth laboratory was formerly called the National Water Quality Laboratory. It basically researches and develops water quality criteria for the U.S. fresh waters. The program that we are developing for the Great Lakes watershed is called the Environmental Monitoring and Assessment Program, or EMAP.

It is likely that the zebra mussels will significantly alter the aquatic populations in our lakes and streams. We are working with the Sea Grant directors of the Great Lakes States to assist in funding the universities in this area for the academic research that is needed. I believe the first projects in this program are being selected this week at a meeting in Ohio which will stimulate some of the work that we see needed in the universities.

My Assistant Administrator for Research and Development, Erich Bretthauer, early on, before the bill was passed, committed resources to call together experts from all over the world on an international workshop on zebra mussels last year. We brought in experts from the Soviet Union who had worked with zebra mussels for a number of years, from Europe——

Senator MOYNIHAN. I'm going to just feel free to interrupt.

Mr. VEITH. Certainly.

Senator MOYNIHAN. There is a point that is not to be passed by, which is that the Europeans live with this problem.

Mr. VEITH. Yes.

Senator MOYNIHAN. And they have not died of thirst.

Mr. VEITH. Under certain circumstances, they are actually using them for beneficial uses of controlling algae in small lakes and streams. In fact, the accounts of some of this activity is provided in the proceedings of this workshop. It's called the Ecology and Management of Zebra Mussels and Other Introduced Aquatic Nuisance Species. I think you have copies we've provided to your staff. I brought some extra copies here. We're currently out right now, but anyone can have the copies on the side table, and if anyone else wants a copy, I'll be glad to send them one.

Senator MOYNIHAN. The members of the press who are present, if you want copies, get them.

Mr. VEITH. This is one of our best-sellers for right now.

[Laughter.]

Mr. VEITH. I won't summarize the report; however, the zebra mussels reproduce and grow under certain natural conditions, such as certain ranges of calcium concentration and nutrients and temperature, and certainly all of the conditions exist in the Hudson River area for that kind of growth. So I think all that you said in your opening remarks and in the proposed bill is consistent with the best scientific facts as summarized in this report.

I believe that a ballast water control program and a very aggressive public education program is the best defense against the spread—

Senator MOYNIHAN. A ballast water. Now, the committee would have said, "Well, you know, that is closing the barn door after the horse has escaped," so help us. We did enact that. Senator Glenn was very much interested in it.

Mr. VEITH. That's right. What I was going to say is it's the only defense against the spread of the zebra mussels at the rate. I agree with you that we are not going to be able to quarantine this organism, but there are—the Great Lakes in particular are being bombarded with many kinds of non-indigenous critters. There is at least four other animals—

Senator MOYNIHAN. So you'd like some ballast control anyway.

Mr. VEITH. Yes. Ballast water control, which is now being developed, I think, for the shipping industry with the Coast Guard, will be important for areas like the Great Lakes or areas that receive major shipping and ocean-going shipping. However, public education in the form of recreational boating—how to clean the boats, how to manage bait buckets and such things—where the public itself is the vector for transporting the zebra mussels—can only be retarded by a public education program. I believe the New York Sea Grant is certainly an appropriate network to reach the public and to carry out this kind of an education program. I would endorse public education to the extent that the public is, in fact, involved in the spread of aquatic organisms from one system to the next.

EPA also has the responsibility for studying the environmental safety of chemicals used to kill zebra mussels in water intake systems. I will provide your staff with copies of these as soon as these studies are complete.

Senator MOYNIHAN. You say here that the addition of chlorine to water intake has proven successful in protecting systems in the Great Lakes?

Mr. VEITH. Yes. The early work, as you may have heard—it was in the press that the city of Monroe, Michigan, had the water intake clogged from zebra mussels. In working with the Monroe officials—in fact, we had some of these experts visit the city of Monroe—they have found that by extending their chlorination line from the pump house out to the tip of the water intake in Lake Erie—

Senator MOYNIHAN. They had chlorinated water anyway.

Mr. VEITH. You have to chlorinate the drinking water anyway. It's a question of where you do it. When they moved it out to the crib in the lake and began chlorination, it seemed to provide the protection for the water supply system, and this is an ongoing experimental effort, but that seems to be a possible fix for systems

that are relatively simple. That is, they have a five- or six-mile line out into the lake.

I think, from what I understand, the system to provide drinking water for the city of New York is much more complex, and I would have to defer to the experts on your panels that you've called today as to whether that's feasible or not. New York City, obviously, has a very complex system compared to the city of Monroe, Michigan.

This concludes my oral statement. I'm pleased to respond to any other questions you have.

Senator MOYNIHAN. Thank you very much, Doctor.

Why don't we hear Mr. O'Neill and Mr. Kahabka, and then we'll continue this.

Well, we know something already, don't we? That Monroe has learned to handle its problems.

Mr. VEITH. I wonder if I could also add that I wouldn't want it to be thought of as a general solution, because if you were to do the same thing for very large utility companies or where you had large amounts of chlorine, then you have the risk of discharging that water out and causing harm to natural populations from the chlorine. It's toxic.

Senator MOYNIHAN. Well, yes. We're going to hear this morning, I hope—at least we're going to hear eventually—about the problem of what do you do with nuclear powerplants, or powerplants generally, but we have nuclear powerplants about 80 or 90 miles south from here.

Mr. O'Neill, we welcome you.

STATEMENT OF CHARLES R. O'NEILL, JR., REGIONAL EXTENSION SPECIALIST, NEW YORK SEA GRANT EXTENSION PROGRAM

Mr. O'NEILL. I thank you very much for the opportunity to speak before the committee again.

This has been quite a week for zebra mussels. I just have returned from a two-day workshop in Kentucky helping the Army Corps of Engineers refine their plan of work for studying the zebra mussel problem as it relates to public infrastructure, so we're primed for it.

New York Sea Grant has been involved in public information, education, and research efforts pertaining to the zebra mussel since October of 1988, paying particular attention to public and private infrastructure impacts and control technologies. My comments today will address the spread of the mussel and the possible impact and control should the mussel reach the New York City water system.

Since the first sighting of the zebra mussel in New York back in October of 1989, in Niagara Mohawk's Dunkirk Steam Station on Lake Erie, the mussels quickly expanded their range throughout the State's Great Lakes waters and connecting waterways. By the end of 1989, they had infested the entire New York Lake Erie shoreline, had progressed through the Niagara River, and were found on a marker buoy in Lake Ontario at that point.

During 1990, the mussels rapidly spread along the entire south shore of Lake Ontario, infesting the water intakes of almost every public drinking water treatment facility and all powerplants that

were drawing water from Lake Ontario, including the Ginna Nuclear Power Plant, the Nine Mile Point nuclear complex, and the Fitzpatrick Nuclear Power Station. The mussels had arrived at the mouth of the St. Lawrence River near Cape Vincent and had colonized the St. Lawrence Seaway Eisenhower and Snell Locks, as well as the Erie Canal from Buffalo to about 20 miles east of Rochester.

Senator MOYNIHAN. Palmyra.

Mr. O'NEILL. Palmyra. Correct.

In 1991, infestations are expected to move into the Finger Lakes, Chautauqua Lake, the eastern reaches of the Erie Canal, the Mohawk River, perhaps as far as the Hudson River at Troy, as the mussel begins its inexorable march inland through the State, and I want to underline that—

Senator MOYNIHAN. You say perhaps as far east as the Hudson River at Troy. They're at the Hudson River at Catskill already.

Mr. O'NEILL. They got a jump on us.

Senator MOYNIHAN. They got a jump on you. Can I make the point for those who are not completely familiar with the water systems of the central United States? Mr. O'Neill, did I hear you say correctly that the zebra mussel is in Lake Chautauqua?

Mr. O'NEILL. We believe it will be in Lake Chautauqua by the end of the summer, if it isn't already there. It probably is.

Senator MOYNIHAN. All right. Because anyone who's interested in the French and Indian wars, if you want to know how the French got to what is now Pittsburgh, then Fort Duquesne, there's a very tiny portage about 10 miles from Barcelona on Lake Erie to Lake Chautauqua, and you can paddle a canoe from Lake Chautauqua to New Orleans. The Allegheny and the Monongahela Rivers meet at Pittsburgh to become the Ohio River. So they're not in New Orleans already. If they're in Lake Chautauqua, in a year's time, they'll be in New Orleans. They just float down stream. So we don't have to wait for the Chicago Canal.

Mr. O'NEILL. Right.

We were surprised this spring when mussel veligers were confirmed in western Lake Ontario—veligers being the early stages of their larvae life span—on April 14. This was far earlier and in far colder water than expected. By early May, we were finding veligers in the central and eastern basins of Lake Ontario as well. That's a very important sighting, because the veligers can be very easily transported not only by currents, but by human influences, and they're the ones you can't see.

Senator MOYNIHAN. We'll call that the bait box phenomenon.

Mr. O'NEILL. The bait bucket, the bilge water in the back of your motorboat, those sorts of things.

We expect it will expand its range in some natural ways, such as currents and attachment to the feet, legs, feathers of shore birds—

Senator MOYNIHAN. That's the question I wanted to ask. Can they get onto a ducks feet? Can they attach themselves to the anatomy of a bird and move in that way?

Mr. O'NEILL. Yes, they can, and if that duck is in the air for a couple hours before touching down in another water body, those mussels, if they're large enough mussels—something more than

just a millimeter or two—can seal their shells tight enough so that they don't have to respire during that time and can easily ride out a several-hour period out of the water and be alive when that duck lands in another uninfested waterway.

Senator MOYNIHAN. And if that duck hasn't received the proper public education——

[Laughter.]

Mr. O'NEILL. Which is why a complete quarantine of infested waters or a complete quarantine of uninfested waters will not work. They may buy time, but they will not work in the long term.

We mentioned human-related dispersal factors, and I believe these will play the most significant role in the spread of the zebra mussel. The mussels can attach to boat hulls, stern engine drive units, even boat trailers when the trailer is in the water picking up a boat. They can live several days out of water if they're not in direct sunlight, if they're kept moist, such as in a bilge area in a motorboat or a live well, up inside the frame of a trailer, in a bait bucket. They could survive out of the lake easily for up to a week to a week and a half and be viable mussels when that vessel gets put into an uninfested waterway someplace else in New York State or in another State, for that matter.

The importance of navigation and irrigation canals, the attachment to the boat hulls, the transport in commercial shipping ballasts, motorboat bilges, what have you, as well as the potential for intentional releases of mussels into uninfested water bodies, shouldn't be underestimated. These are going to be very major transmittal vectors.

On May 6 of this year, researchers from Cornell University confirmed that zebra mussels were growing on freshwater clam shells in the eastern end of Oneida Lake, which is part of the Erie Canal system.

Senator MOYNIHAN. So there you have—again, for my fellow New Yorkers from the east, you cross from Palmyra to Oneida in one year. It's about a third of the canal system. We're watching this, but just the literature of the movement of something like this—I don't know how developed that is, but you have a nice opportunity to do it here, don't you?

Mr. O'NEILL. Yes.

This wasn't unexpected. I would have been surprised had the mussels not shown up there by July or August; it just happened sooner.

Senator MOYNIHAN. May 6 is early.

Mr. O'NEILL. However, then on or about May 19 of this year, a commercial fisherman fishing for sturgeon right here on the Hudson River in Catskill¹ found striped mussels attached to freshwater clam shells in the vicinity of the Rip Van Winkle Bridge. I believe he was seining in 10 feet of water off of Rogers Island. His son, who has worked with Cornell's Hudson Bass Survey, thought he recognized what these were. They were sent immediately to Cornell University's Biological Field Station, where a preliminary identification of zebra mussels was made by Dr. Ed Mills. This identification was corroborated the next day by Dave MacNeill, our Sea Grant biologist, and confirmed on May 23 by Dr. James Carlton, who is the Director of the Maritime Studies Program at Wil-

liams College in Mystic Seaport, Connecticut. Jim is an internationally recognized expert on marine exotic organism introductions.

Since that time——

Senator MOYNIHAN. Could I just ask once again what was the name of the young man who sent them to——

Mr. O'NEILL. The person who found them was Everett Knack and his son, Steve Knack.

Senator MOYNIHAN. The committee would like to express our appreciation to these good citizens. Make sure we get their address so we can thank them personally. I mean, we need to have that sort of alertness to move the information along.

Mr. O'NEILL. Since that time, they have found—that was only two zebra mussels on two unionid shells. Since that time, additional mussels have been pulled out from the Hudson River attached to more clam shells, to rocks, to submerged, waterlogged driftwood in waters between 10 and 50 feet deep while gill netting in the main channel of the river, again, upstream and downstream of the Rip Van Winkle Bridge between river miles 112 and 115.

Now, we don't know the actual transmittal vector of these mussels winding up in the Hudson River here. They are between a quarter of an inch and a half-inch in length, which means they are last year's vintage. They could have been——

Senator MOYNIHAN. Oh, that's the real creature.

Mr. O'NEILL. That's it.

They could have been brought here via direct water from the Erie Canal as larvae flushed into the Hudson River; they could have been brought here on the hull of a boat that traveled through the canal and down the Hudson River; they could have been brought here by a motorboat on a trailer from infested waters that got launched and tied up at the marina at the mouth of Catskill Creek; they could also possibly have been discharged into the Hudson directly by an international commercial vessel sailing upstream to the Port of Albany and discharging ballast. At this point, there's no way for us to know how the mussels got there. We do know that they are there, and we know that we did not expect to see them there until very late in 1991. Again, they have moved much faster than we expected.

This is the most eastern occurrence of the mussel in New York. It's also significant in that it is the first confirmed sighting of the mussel in the United States outside of the Great Lakes drainage basin, as you alluded to before. Everything prior to this has always been in that drainage system. Now, with the mussel here and with the mussel poised to enter the Mississippi system south of Chicago and poised to enter the Allegheny system via Lake Chautauqua, I would have to say that the genie is out of the bottle. The mussel has made that boundary jump and is now moving into inland waters more rapidly than we would have thought two years ago.

The effects of the mussel spread throughout New York's inland waters will be felt by almost all surface water users, whether they're anglers, fishery resource managers, recreational boaters, commercial navigators, people who own shoreline property using the lakes for recreation and camp water, as well as raw water users, such as electrical power generators, industries, and public water treatment facilities. Zebra mussels are already fouling raw

water intakes at electric power generation and public water supply filtration facilities throughout our Great Lakes coast, and they're reducing intake heads, they're clogging heat exchangers, they're entering cooling, lubricating, air conditioning, even fire fighting emergency service lines.

We estimate at Sea Grant that the cost of controlling the zebra mussels impacts on New York public water treatment and power generation facilities alone, both Great Lakes coast and inland locations, may total more than \$500 million over the next 10 years. No fresh surface water user, not the smallest mom-and-pop campground, not the cottage owner on the St. Lawrence River in the Thousand Islands, not even the city of New York with its vast upland reservoir system and aqueduct system—none of those users can be assumed to be immune from the zebra mussel and its impacts.

Looking at the New York City water supply, given that it is probable that the zebra mussel will, at some time in the future, be transported by natural- or human-influenced vectors into one or more of the city's upland reservoirs, it would be prudent for the city of New York or any municipality drawing its water from a surface supply to begin to study their situation and to plan for the future. In the case of New York City, the physical and limnological characteristics of the upland reservoirs, such as substrate, water chemistry, temperature, primary productivity, all need to be studied now to determine how severe colonization may be should the mussel get into the system.

The aqueduct system itself needs to be studied in terms of predicted extent of reservoir infestation to determine how far down the aqueducts colonization could take place and how severe that infestation could be, given the distance from the mouth of the aqueduct. It's also important to forecast how far downstream there will be enough food in the water for any larvae spawned by mussels living in the mouths of the aqueducts to send live mussel larvae south toward New York City through basically an unfiltered water system. We have to know can they colonize further down the system than we've seen them in two- or three-mile pipelines? Finally, once that information is known, potential point of intake or downstream or end-user control alternatives will need to be studied to minimize and mitigate those impacts on the system.

Looking at New York State as a whole, the response to zebra mussels needs to be a coordinated, multi-disciplinary combination of monitoring programs, research into control, and education in coordination with the Federal agencies doing these same types of activities. New York needs to begin to plan for dealing with the mussels impacts on both its public and private infrastructure. These plans should be prepared immediately, as provided for under the Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990.

Senator MOYNIHAN. We're going to have to think up an acronym for that, and there will be a prize, unstated at this point. Anybody in the audience who can think of one before the hearing is out, there will be a prize.

[Laughter.]

Senator MOYNIHAN. We'll never get any of this work done if we keep having to pronounce that. You could almost quantify the time that will be lost repeating the name of that act.

Mr. O'NEILL. Dr. Veith mentioned the need for public information and education, and I believe that New York Sea Grant and our current Zebra Mussel Information Clearing project do stand ready to assist the State and Federal Government in doing just that, getting that information out.

I brought a few samples that I will leave with you today, including a map showing the extent of colonization throughout the Great Lakes, which is updated every two months.

We have a bimonthly research and trial-and-error-based journal, the Zebra Mussel Information Review——

Senator MOYNIHAN. Oh, it's called *Dreissena Polymorpha*.

Mr. O'NEILL. That is published by our clearinghouse and currently goes to utilities, government agencies, you name the audience, throughout New York State and the Great Lakes region, and aimed at the boaters who can potentially be carrying the mussels on and in their boats are posters and brochures warning them not to pick up hitchhikers, telling them how to de-mussel a boat leaving infested water. I'll leave all of these with you for the committee.

Senator MOYNIHAN. I thank you, Mr. O'Neill, but I ask you, how are you going to give that poster to ducks? How do you get ducks to read posters?

[Laughter.]

Senator MOYNIHAN. Mr. Kahabka, that's not the least of the problems that the New York State Power Authority has dealt with in its time. We welcome you, sir, and let's hear what an operator has to deal with.

STATEMENT OF JOHN KAHABKA, SENIOR ENGINEER, NUCLEAR GENERATION DEPARTMENT, NEW YORK POWER AUTHORITY

Mr. KAHABKA. Good morning. My name is John Kahabka. I'm a Senior Engineer of the Nuclear Generation Department of the New York Power Authority, and my responsibilities include interfacing with regulatory agencies, local governments, and consulting personnel to ensure that commitments related to a variety of environmental programs at the Power Authority are maintained in an environmentally compatible manner. I wish to express my appreciation for your invitation to appear here today and to provide you with an update on the Power Authority's efforts regarding an issue which is of critical interest to us and our customers.

We appeared before this subcommittee about a year ago to discuss our concerns relating to the potential effects of zebra mussels on our operations at our plants. Since then, our worst fears have been realized as the zebra mussels have completely transversed the Great Lakes and have expanded into the Hudson River, and they threaten to reach the Mississippi drainage system. Once again, we're grateful to you, Senator Moynihan, and your subcommittee for your continued interest in this very serious and costly environmental problem.

First, I'd like to provide some background on the New York Power Authority. We are the Nation's largest non-Federal public power organization and provide about a quarter of the electricity used in New York State. We are a non-profit public corporation which finances, builds, and operates electric generating and transmission facilities for the purposes specified in our legislative charter.

We do own and operate two nuclear powerplants, two major hydroelectric facilities, several small hydro facilities, a pumped storage facility, and an oil/gas fired plant, virtually all of which are dependent on water from the Hudson River and the Great Lakes. The Indian Point 3 nuclear powerplant, which is located near Buchanan, New York, on the Hudson River—

Senator MOYNIHAN. That's what President McCord was referring to.

Mr. KAHABKA. —serves the electric needs of all the public entities in Westchester County and New York City. This franchise of government customers includes the Metropolitan Transportation Authority, the New York City Housing Authority, municipal facilities, hospitals, and city and county school districts, who depend entirely on the Authority for its source of electricity. The use of this less expensive electricity will save Westchester and New York City residents billions of dollars over the next decade.

Our other nuclear powerplant, the James A. FitzPatrick plant, is located near Oswego on Lake Ontario. Power from the FitzPatrick plant is sold to utilities throughout the State, and half of the capacity is dedicated to fostering economic development throughout New York State. FitzPatrick power is provided to customers such as the Grumman Corporation on Long Island, Chase Manhattan Bank in New York City, and General Motors in Westchester.

Our two major hydroelectric power projects are powered by the waters of the Great Lakes Basin. The St. Lawrence-Franklin Delano Roosevelt Power Project is located in Massena, New York, and the Niagara Power Project is located on the Niagara River, approximately four and a half miles north of Niagara Falls. Production costs at our Niagara and St. Lawrence facilities are among the cheapest in the country, and this power is critical to the economic well-being of all the New York customers it serves, both industrial and residential. Since virtually all of our generation comes from thermal and hydro facilities located on inland waters, the Power Authority considers a permanent solution to the infestation of zebra mussels to be critical to the continued economic operation of these facilities.

Available information indicates that to date the mussel has migrated throughout the Great Lakes, into the Erie Barge Canal up to Palmyra, and possibly beyond. It has recently been discovered in the Finger Lakes and, notably, discovered last week in the Hudson River, which is the first U.S. sighting outside of the Great Lakes drainage basin.

Recognizing the need for immediate measures to address the problem, early in 1990 the Power Authority instituted monitoring and mitigation programs at a number of our facilities throughout the State. Monitoring allows us to determine the concentration of

the mussel larvae in the water column, the settling and infestation rates, and eventually the growth rate of the mussels.

Unfortunately, there are limited mitigation options for control of the zebra mussel. Technology currently available entails the discharge of chemicals, either chlorine or molluscicides, into water supply systems, which, in New York, requires approval from the Department of Environmental Conservation—the DEC. This approval generally takes the form of an amendment to the facility's State Pollution Discharge Elimination System permit, or SPDES permit. The Power Authority has received approval from the DEC for the implementation of chlorine systems at our Niagara and Indian Point 3 projects and at our FitzPatrick plant. The effectiveness and the impacts of the chlorination systems will be closely monitored by both the Power Authority and the DEC.

In May of 1990, we instituted a chlorination program at our Niagara hydro project that chlorinates service water-type support systems of the plant. These systems include our fire protection system, transformer cooling, and bearing cooling systems. The main flow system utilized for power production at the project is not chlorinated. At our hydro facility in St. Lawrence, we have designed and are currently installing a system for chlorination similar to that at Niagara—

Senator MOYNIHAN. Are these closed systems?

Mr. KAHABKA. No, these are open systems.

Senator MOYNIHAN. So you discharge this water?

Mr. KAHABKA. Yes, but these are minor systems in that the total amount of water used is insignificant compared to our main flow system.

We hope to have the one at St. Lawrence in place by the end of the summer pending DEC approval.

At the FitzPatrick nuclear plant, a chlorination system was installed and has been operational since March of 1991. This system is also used to treat service water-type support systems at the plant. Here again, we do not treat the main cooling water at this site.

The cost for implementing the chlorination technology at our Niagara project and FitzPatrick project has been \$175,000 and \$100,000, respectively.

A monitoring and mitigation program has recently been implemented at our Indian Point 3 site in Buchanan. The program consists of monitoring for both veligers and settled mussels. The site currently does have a chlorination system in place that has to be upgraded in order to maximize its effectiveness. We have the necessary approval for the utilization of this system. The water systems treated at this location, again, are the service-type water systems.

The two systems which are likely to be affected by the mussels at Indian Point are the service water systems and the main condenser cooling water systems. The mitigation program at the plant consists of a chlorination system for service water, which we expect will provide adequate protection for that system. The program also consists of part-time chlorination of the main cooling water condensers for up to six hours per week.

We do expect that any mussel proliferation problem will be seasonal due to the salt water intrusion at the Indian Point site.

Senator MOYNIHAN. Yes, that's a point to record, that this mussel will not live in salt water, in normal ocean water.

Didn't we have a nuclear plant on Long Island at one point?

[Laughter.]

Mr. KAHABKA. Yes, at one point.

As you have just stated, salt water is lethal to the mussel when it is present in sufficient concentrations. Those power generating stations located above the traditional salt front will experience a year-round problem with the zebra mussel.

We are currently reviewing options for control systems at our 1,000 megawatt pumped storage facility at Blenheim-Gilboa in up-state New York as well as for our Hinkley, Crescent, and Vischer Ferry small hydro facilities, which are located on the Mohawk River north of Albany in Saratoga and Schenectady Counties.

By interfering with the maximum effective operation of our plants, zebra mussels could jeopardize the reliable economic supply of power to a wide variety of critical components in the State. Power production from these facilities could only be replaced by more expensive, less environmentally compatible energy sources. The worst case impact of Dreissena on Power Authority operations would be the total interruption of electric generation to allow mechanical maintenance of affected systems.

Senator MOYNIHAN. OK. What you mean is you close down and just start scraping?

Mr. KAHABKA. Basically, that's it, yes.

It's difficult to definitely quantify the potential financial worst case impact under such a scenario; however, replacement costs for power, based upon current avoided cost estimates within the New York Power Pool, would be approximately two times greater for power at Indian Point and seven and a half times greater for power from the other hydro facilities. The net average daily added cost of replacement power for Indian Point 3, making certain availability assumptions, amounts to \$722,000 a day.

Now that the mussel has made its way into the Hudson, our concerns have intensified that the worst case may at some point become a reality. Although our Indian Point plant may only have to combat the mussel on a seasonal basis, Niagara Mohawk Power Corporation and Central Hudson Gas and Electric both operate facilities located on the Hudson River above the salt front.

Senator MOYNIHAN. Above? Your text says below.

Mr. KAHABKA. Yes, there is a correction. It's above the salt front.

The utility industry has moved to cope with the Dreissena problem at several levels. At the National level, in 1990 the Electric Power Research Institute—EPRI—formed a Zebra Mussel Advisory Group to disseminate information, coordinate monitoring and control technologies, and fund appropriate research projects. EPRI is currently pursuing patents for several chemical molluscicides which have been proven effective in treating the mussels.

In New York State, the Empire State Electric Energy Research Corporation—ESEERCO—that consists of the State's seven investor-owned utilities and the Power Authority recently extended an agreement with New York Sea Grant for a zebra mussel information clearinghouse, which is essentially a technology transfer effort. Another effort under way is a State-wide zebra mussel moni-

toring project that will provide early warning of the mussels' dissemination through monthly sampling of various sites throughout the State. New projects being funded include experimentation to identify naturally occurring microbes that are detrimental to the mussel, as well as the continuation of a project utilizing sound, which analyzes the use of different frequencies, amplitude, and duration of exposure to induce mortality in the mussel. ESEERCO has also funded a project to determine the effects of various levels of salinity and turbidity on the mussel.

In closing, I would like to congratulate you, Senator Moynihan, and the members of the committee on the success of last year's efforts to authorize funding for research and control programs. The Power Authority supports the provisions of S. 36, introduced earlier this year by yourself, which seeks to develop monitoring, control, and prevention programs throughout the New York City water supply system.

We are encouraged by the recent request of the Senate Great Lakes Task Force for \$83 million in appropriations to launch a comprehensive control effort against the mussel and other pollutants in the Great Lakes. With the recent discovery of the mussel in the Hudson, we feel that additional research to provide a permanent solution to the mussel problem is vital to keep the mussel out of the metro area's drinking water and energy supply system.

We at the Power Authority feel that the continued infestation of the zebra mussel presents one of the most significant environmental challenges of the 1990's for the users of the waters of the Hudson River and the Great Lakes. We applaud the efforts of Congress to find timely and environmentally compatible solutions to this problem.

Thank you.

Senator MOYNIHAN. We thank you.

Talking about what the worst case scenario is, I wonder if I could ask Dr. Veith, is there any prospect for the kind of brilliant biology that we saw with the lamprey eel? I mean, we developed the lampricide. The lamprey eel in Lake Erie was just wiping out fish, and by a hugely elegant device, they found a lampricide that would just wait and get to the eggs deep in the mud. Is there a prospect of this sort or has anybody tried anything like that?

Mr. VEITH. Well, let me just preface my comment by saying that, in general, controlling the ecological explosions like this of introducing species are not generally solved by intervention. I mean, once they happen, the system accommodates in some way. You may come up with a predator. I mean, there are natural predators to the zebra mussel.

Senator MOYNIHAN. Mr. O'Neill is nodding. Name one.

Mr. VEITH. Diving ducks and several species of fish. In the European and northern Russia waters, there is a carp that has co-evolved with this organism, and I'm a chemist, but my understanding is that it has hard teeth or it can grind them up, and the species in North America don't have that. We may have species that control it eventually, but they may not be species we necessarily want. That is, if we replace a walleye population with a carp population, that may not be something in the public interest.

But nevertheless, generally there will be some kind of natural control placed on this organism. However, there are a few really outstanding examples where research has paid off. The sea lamprey is one of the other introduced nuisance species in the Great Lakes—

Senator MOYNIHAN. For those who don't know in the audience because we are over here on the eastern end of the State, the sea lamprey made its way into the Great Lakes system just as the mussel and threatened to just wipe out the fish population, and a Fish and Wildlife Service researcher developed—after 798 experiments, he found one that worked, so it's under control now.

Mr. VEITH. Well, it took advantage of some very unique life cycle properties of the organism and then designed a silver bullet, if you would, for that particular life stage. The organism had a vulnerability. Scientists discovered how to control it, and it is a remarkable success, and it's still ongoing, as a matter of fact, in the Great Lakes Fisheries Commission.

We have several programs going or projects planned here on the zebra mussel. They hinge around areas where zebra mussels explode in an infection, reach a climax, and then die. There are natural disease organisms that take over and kill the mussel. Normally when you crowd animals too close together, disease is proliferated. We are looking at the natural bacterial fauna or the natural things that cause disease in animals like a zebra mussel, which grows very close together. Many species have unique fauna.

The Office of Research and Development at EPA also has a biotechnology program that is looking at how to culture and modify organisms' biological control agents. Many of the new pesticides are likely to be biological control rather than chemical, and they take advantage of natural susceptibilities of the organism. So our major research effort is to combine some biotechnology work with natural ecology and hopefully find the vulnerability for this organism. We would not want to hold this out as a way of ridding it from fresh waters, but in places where there is a particularly large impact on public funding or vulnerability of a city like the size of New York, certainly it might justify a measure like that to prevent it.

So biological control is going to replace chemical control in many areas simply because it can be designed unique to a species much more than broad spectrum pesticides, and that's what we are hoping to do. That is long term and general. It will not perhaps address the immediate concern here of the zebra mussels moving into this intake system.

Senator MOYNIHAN. Well, we thank you.

Mr. O'Neill, you were nodding agreement.

Mr. O'NEILL. Yes. There's work currently being funded by ESEERCO and under review by Sea Grant from some of the same people who had developed BTI, which is a microbe that attacks black fly larvae and it's being used with quite a bit of success in the Adirondacks to help check the black fly population.

Senator MOYNIHAN. Why would you want to do that? What's wrong with black flies?

[Laughter.]

Mr. O'NEILL. Until you've tried to breathe in a cloud of black flies—

Senator MOYNIHAN. If you don't like it, you don't have to go there. They haven't done any harm. What have the black flies ever done to you or me?

[Laughter.]

Senator MOYNIHAN. Now, gypsy moths—

Mr. O'NEILL. There you go.

Senator MOYNIHAN. We've got gypsy moths. We don't have black flies in Delaware County.

Mr. O'NEILL. But the same team is applying some of the same technology right now to screening, I believe, 275 known microbes that have a potential for a toxic effect with an organism such as a bivalve mollusk. Again, there is no guarantee something like this will work or will work at least within the next couple of years, but long term—

Senator MOYNIHAN. It's an interesting way to think about something like that.

Mr. O'NEILL. Right.

Senator MOYNIHAN. Well, gentlemen, we want to thank you very much and to encourage you to study on.

I'm going to come up with NINPAC for my entry into the acronym contest. It's properly NIANPCA, but we have NIMO for Niagara Mohawk, and Nine Mile Point, and we all have PACs, or will have until we reform politics, so what's wrong with NINPAC? It's a thought. People have to work at these things, right? You keep working at it until something succeeds.

Dr. Veith, Mr. O'Neill, and Mr. Kahabka, we thank you very much. It's not the last time we'll hear from you, and we do very much appreciate your coming all the way from Duluth for this.

Senator MOYNIHAN. Now we will have our second panel of the morning. We're running right on time, maybe a few moments late.

We're very honored to have Colonel Ralph Danielson, who is our District Engineer of the New York District, and he is accompanied by Dr. Andrew Miller, who has come all the way here from Vicksburg, which is very generous of you to do; and Commissioner Joseph Conway of the New York City Bureau of Water Supply, who has got the most immediate concerns here.

Colonel Danielson, if you would like to begin, sir?

STATEMENT OF COLONEL RALPH M. DANIELSON, COMMANDER AND DISTRICT ENGINEER, NEW YORK DISTRICT, U.S. ARMY CORPS OF ENGINEERS, ACCOMPANIED BY ANDREW C. MILLER, RESEARCH LIMNOLOGIST, U.S. ARMY CORPS OF ENGINEERS WATERWAYS EXPERIMENT STATION, VICKSBURG, MS

Colonel DANIELSON. Mr. Chairman, I'm very pleased to be here today to represent the Secretary of the Army in this discussion of the zebra mussel and its impact on our water resource infrastructure, particularly here in New York.

As you have noted, accompanying me today is Dr. Andrew Miller, who is a research limnologist at the Army Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi. I might note that Dr. Miller is the senior scientist in the Corps of

Engineers responsible for the research efforts on the zebra mussel at this time.

I do have a prepared statement which I will submit for the record. In the interest of time, perhaps I can summarize some of the key points.

Senator MOYNIHAN. By all means, do that, but don't do it in the interest of time. We've brought Dr. Miller all the way from Vicksburg, and we want to hear him, and we want to hear you, Colonel.

Colonel DANIELSON. My prepared statement and what I will summarize focuses on the problem in general—and others have addressed that already—what the Corps of Engineers has been doing over the past couple of years in the area of the zebra mussel problem, and what our plans are for future efforts and what we could be doing to assist in managing the Hudson River infestation.

As has already been noted, zebra mussels are small organisms, about half an inch long, but the encrustations formed by multitudes of this species are what are of concern, in that they can form colonies that will have an impact on locks and dams, which are of particular interest to the Corps of Engineers, hulls of recreational and commercial vessels, cooling plants, and on dredges, tugboats, navigation buoys, and the nets of commercial fishermen that remain in water for long periods of time. Most significantly, it's the impact that this organism can have on public equipment and facilities associated with municipal water supplies. By their numbers, they can obstruct the flow of water through pipes and interfere in the operation of mechanical equipment.

It's been reported by Congress that this species could spread throughout two-thirds of the United States and cause \$5 billion in damage by the year 2000. I might note—and Dr. Miller perhaps would want to comment on this later—that that perhaps is a conservative estimate, because it's already been noted, for example, that another somewhat exotic species called *Corbicula*, or the Asian clam, now accounts for about \$1 billion a year in costs to the power industry in the United States.

Senator MOYNIHAN. Is that on the West Coast mostly?

Colonel DANIELSON. Pretty much throughout.

Mr. MILLER. It would be throughout the United States.

Senator MOYNIHAN. It spread, too?

Mr. MILLER. Yes.

Senator MOYNIHAN. The Asian clam.

Mr. MILLER. Yes.

Colonel DANIELSON. There are some characteristics of the zebra mussel that make them particularly noxious. Unlike native mussels which are found on or slightly beneath the surface of sand or gravel shoals in rivers or lakes, this species has a stout holdfast, or byssus, which enables it to tenaciously attach to fairly smooth structures, such as steel or concrete. Their immature stage is free-swimming, but as adults they can attach themselves to driftwood, hulls of boats and barges, or the surface of other objects in the water, as others have already noted, and thus, they can be transported over scores of river miles. The zebra mussel tolerates extreme crowding—up to 750,000 individuals per square meter—and as was seen in that small section of pipe passed around, they can be a very dense colony of species. As has been noted, they're re-

stricted to fresh water or very slightly brackish water, and so are found predominantly in our fresh water rivers and lakes.

Because of the likelihood that the zebra mussels will become a serious invasive pest at lock and dam facilities, water supply systems, and other public facilities, the Corps of Engineers has undertaken efforts to investigate species-specific control methods and procedures. Our comprehensive program involves coordination with Federal, State, and local governmental agencies and academic personnel and is based on biological, ecological, and physiological information. Ongoing studies by the Corps and others on large waterways will be integral components of the program.

Sir, as you noted in your opening statement, the Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990—

Senator MOYNIHAN. NINPAC.

Colonel DANIELSON. —was passed and signed into law this last November, and the act established the Aquatic Nuisance Species Task Force, and under the law, the task force is directed to develop and implement a program for the waters of the United States to prevent introduction and dispersal of aquatic nuisance species, to monitor, control, and study such species, and to disseminate related information. The membership in the task force consists of the Director of the U.S. Fish and Wildlife Service, the Under Secretary of Commerce for Oceans and Atmosphere, the Administrator of the Environmental Protection Agency, the Commandant of the Coast Guard, and the Assistant Secretary of the Army for Civil Works. This task force will be responsible for preparation of the aquatic nuisance species report to Congress required by the legislation.

Specifically, the law directed the Army, in consultation with the task force, to develop a program of research and technology development for the environmentally sound control of zebra mussels in and around public facilities. The Assistant Secretary of the Army has tasked the Corps of Engineers with developing the research and development program for the control of the zebra mussel.

Senator MOYNIHAN. Colonel, forgive the interruption.

For those who are not familiar with the terminology, the Assistant Secretary of the Army for Civil Works has the civil side of the U.S. Corps of Engineers as his operating agency, so that's how the Corps of Engineers is directly involved, and thank God they are.

Colonel DANIELSON. Thank you, sir.

Information that we gather from this effort will be made available to Federal, State, and local water managers in the forms of workshops, meetings, Government reports, and scientific papers.

In response to the directive to develop a research program, the Corps, through its Waterways Experiment Station and Dr. Miller's efforts, has undertaken the following activities: identification of points of contact in the Corps of Engineers, the U.S. Fish and Wildlife Service, and other Federal and State agencies, and academia; consolidation of existing information on zebra mussels from literature and conferences; initiation of preliminary studies on potential control methods with the Center for Biological Macrofouling; development of a four-year research and development plan, including ongoing technology transfer; and as recently as the last two days, hosting of an interagency workshop to discuss techniques for controlling zebra mussels.

Senator MOYNIHAN. Where did you do that? Down in Vicksburg?
Mr. MILLER. No, in Fort Mitchell, Kentucky. I'm on the way home, actually.

Colonel DANIELSON. The objective of this research program is to investigate techniques for, as I mentioned earlier, the environmentally sound control of the mussels in and around public facilities. It consists of the following major components.

Management information and transfer. There is already some information about the zebra mussel in the scientific literature of Canada and Europe and others, as discussed here today. As noted, the European industry has been living with this pest for a number of years now. We will be looking at the best ways to transfer this information, together with what we learn with our own research, to water managers.

Environmental effects of zebra mussel introduction and colonization. In rivers and lakes, we will be studying the effect of zebra mussel infestations on water and sediment quality, native mussels and other invertebrates, and fish-spawning sites.

Another item that we'll be addressing is control methods. We will be looking at specific methods to reduce the population of zebra mussels at a site and limit their infestation. We will apply the results of research on such things as desiccation, thermal tolerance, and its holdfast, or byssal thread, characteristics.

We will also be looking at the issue of stressing the organism, examining the biochemical and organismal stress indicators. These are things like the chemical balances within the body, the tissue condition, and oxygen consumption. We feel that better understanding the mussel's physiology will permit us to analyze the effects of various control methods.

Attention will also be directed to the effects of suggested techniques, such as application of molluscicides, toxic or non-toxic coatings, and physical control methods, as I've already mentioned, such as desiccation and thermal stress, and we will be addressing the environmental effects of these techniques and materials also.

Although the Fish and Wildlife Service has the mandate for monitoring the spread of zebra mussels, the Waterways Experiment Station will conduct and has already begun conducting limited studies on the distribution of this pest as a part of its research program. During this current month, the Waterways Experiment Station has contracted with a laboratory on the Illinois River to regularly sample water and sediments for immature and adult zebra mussels. In addition, the laboratory will analyze commercially available compounds that, when applied to concrete or steel surfaces, may repel zebra mussels.

The Waterways Experiment Station will also fund additional laboratories this coming fiscal year 1992. We anticipate that one laboratory will be on the upper Ohio River, one on the upper Mississippi, and one here on the Hudson River.

Senator MOYNIHAN. One here on the Hudson? Where do you think that would be?

Mr. MILLER. That hasn't been determined yet.

Senator MOYNIHAN. What's wrong with Catskill?

Mr. MILLER. Well, that's certainly a possibility.

Senator MOYNIHAN. Colonel?

Colonel DANIELSON. Along with the other Federal members of the task force, the Corps will continually transfer the knowledge gained from these efforts to State and local governments.

I might note, as others have already noted, the appearance of the zebra mussel in the Hudson cannot probably be too surprising, given the nature of the organism and its ability to be transported, and there is perhaps little that could practically have been done to prevent its transport. So the presence of the zebra mussel in the Hudson or, indeed, any of the waters of the United States is rightfully generating considerable concern, because, as has already been noted, where it is present, it's greatly reduced the efficiency of municipal and industrial water supply systems and water control structures. Also, as with the introduction of other exotic species, native plant and animal populations and communities have also been affected.

We're probably not going to be able to vaccinate our rivers and lakes to prevent the spread of this pest. We may be able to eradicate it temporarily in some areas, and we perhaps can slow its growth in some places, but mainly we're going to have to learn to live with the zebra mussel and perhaps change some of our maintenance practices and replace some of our equipment to deal with the problem.

As I mentioned, the Europeans have been living with this pest for several years and have developed ways to cope with the organisms. For example, often in Europe water systems will operate twin water intake structures so that one can be shut down for cleaning while the other is still operating. For example, other things that have apparently been used successfully in powerplants include using a steam injection into the pipes to kill the mussels that have attached there. We believe the results of our research will provide additional options for Federal, State, and local water managers to consider.

In conclusion, we are looking at the full potential geographic range of the zebra mussel, but, of course, New York City and the communities in this area will also benefit from those widespread findings. Specifically for this area, my district, the New York District, can offer technical assistance on the New York City water supply system. Currently, we could do that either through the Planning Assistance to States Program, authorized by section 22 of the Water Resources Development Act of 1974, or we could currently, on a reimbursable basis, provide assistance under the Intergovernmental Cooperation Act and section 922 of the Water Resources Development Act of 1986.

Senator MOYNIHAN. Colonel, don't mention reimbursable in New York State with these particular seats.

Colonel DANIELSON. Bad time to mention that, yes, sir.

[Laughter.]

Senator MOYNIHAN. You won't ever hesitate—and you all never do—to let us know if the statutory authorities that you would like to have are lacking? If you need more or whatever, you will, of course, tell us.

Colonel DANIELSON. Yes. As I mentioned, the NINPAC is the principal authority that we are operating under now and principally the authority that the Waterways Experiment Station is operat-

ing under now in looking at our activities with respect to the zebra mussel.

Senator MOYNIHAN. I wonder if we could now hear from Commissioner Conway and then give Dr. Miller a chance to have the scientist's last word in telling us how well he thinks these operating engineers are doing.

Commissioner, we welcome you here.

**STATEMENT OF JOSEPH P. CONWAY, ASSISTANT COMMISSIONER,
BUREAU OF WATER SUPPLY, NEW YORK CITY DEPARTMENT
OF ENVIRONMENTAL PROTECTION**

Mr. CONWAY. Thank you very much, Mr. Chairman.

My name is Joseph Conway. I'm the Director of New York City's water supply system, and I thank you for the opportunity for New York City to present an overview of the problem as viewed by the managers of this system.

The problem is that zebra mussels can enter New York City's water supply reservoir system and, hence, cause disruption by multiplying in and thereby clogging water tunnels or other water conduits. Zebra mussels often cluster aroundwater intake pipes, which provide a moving source of food. Each female can produce between 30,000 and 40,000 offspring per year, and older females have been found to produce up to a million offspring per year.

Once zebra mussels have entered a water supply, it is very difficult to effectively get rid of them. Most water suppliers use chlorine to kill zebra mussels, although this can result in elevated levels of trihalomethanes. Other methods, such as the use of ozone, potassium permanganate, biocides, high-frequency sounds, electrical shocks, heat, et cetera, are some of the techniques that are used in tackling this problem for water suppliers and are on the agenda of those researchers looking at dealing with water supply concerns, which are somewhat different than the power companies'.

Some of the limiting factors that affect the population growth of zebra mussels include water temperature and calcium concentrations. As far as temperature is concerned, zebra mussel spawning generally begins when water temperature reaches 12 degrees centigrade or 54 degrees Fahrenheit. Optimum spawning occurs between 18 and 21 degrees centigrade or—

Senator MOYNIHAN. That's warm water, isn't it?

Mr. CONWAY. Yes. Or 72 degrees Fahrenheit. Below 54 degrees Fahrenheit, little spawning activity takes place.

With regard to calcium, zebra mussels become stressed if the calcium concentration in a body of water is as low as 10 to 12 milligrams per liter. There is no maximum concentration of calcium, since calcium intake is related to shell formation.

Other limiting factors include water currents. Optimum water currents are between 0.15 and 0.5 meters per second for proper growth. Hard substrate. The zebra mussels, as has been stated previously, must have a hard surface they can latch onto, such as dock pilings, pipes, et cetera. However, they are very adaptable and can even latch onto clam shells. Food source. Zebra mussels need sufficient phytoplankton or bacteria as their food source.

As they relate to New York City's water supply, these limiting factors are as follows. An analysis of the New York City reservoirs shows that our reservoirs achieve temperatures conducive to reproduction of zebra mussels between the months of May through October. The water temperatures appear to be too cold for spawning during the rest of the year.

Senator MOYNIHAN. So for half the year they can spawn.

Mr. CONWAY. Right.

In our East-of-Hudson system, which is the system primarily located in Westchester and Croton Counties, in the concentration of calcium in Kensico reservoir, for instance, the mean concentration varies between 3.73 and 5.87 milligrams per liter; in the West Branch reservoir, the mean is between 6.53 and 8.64; and in Lake Gilead in Croton County, the mean is between 9.14 and 11.21. This is low enough so that it is unlikely that zebra mussels could survive and reproduce. However, all of the other reservoirs and controlled lakes in the Croton system have calcium concentrations that appear high enough for zebra mussels to exist. That means it's anywhere from 12.64 to a high of 23.28 in each of the Croton reservoirs.

Senator MOYNIHAN. So on the East-of-Hudson system, you have a spawning period and a nutrition that is sufficient to have all the zebra mussels you could look for.

Mr. CONWAY. In the Catskill/Delaware system, which is much closer to this area, the reservoirs have calcium concentrations lower than 10 milligrams per liter, generally between 3 and 8 milligrams per liter. Thus, it would appear that zebra mussels could not survive and reproduce in these waters. In comparison with our water supply reservoirs, the Great Lakes, which are being presently overrun by zebra mussels, have calcium concentrations as high as 180 milligrams per liter.

Senator MOYNIHAN. Can I ask just an innocent question? Where does that calcium concentration—what's the variable here? Is it plant life?

Mr. MILLER. I'm not familiar with the area, but it's the local geology—

Senator MOYNIHAN. Is it the geology?

Mr. MILLER. Limestone in some areas is being leached into these reservoirs.

Senator MOYNIHAN. OK. So it's fairly constant.

Mr. MILLER. Yes, that's right. It won't change unless running water dilutes it or something like that.

Senator MOYNIHAN. OK.

Mr. CONWAY. It has been pointed out that the 10 milligrams per liter limit has been derived from the European literature. Although there is nothing in the experience of utilities in the United States that has shown that zebra mussels can survive in waters having lower concentrations of calcium, this cannot be stated for certain. The American experience with zebra mussels is relatively new, since they were first discovered in the United States in Lake St. Claire in June 1988.

It was decided—

Senator MOYNIHAN. Being a good engineer and a City College man, you've decided that with anything this new, you should not assume you know all that's going to ever be known about it.

Mr. CONWAY. I learned that at City College for sure.

[Laughter.]

Mr. CONWAY. It was decided within our agency that some of our reservoir water should be tested to see if it permits zebra mussel survival and reproduction. This suggestion was brought to the attention of Acres International Corporation, specialists in the field. Acres stated that such an experiment probably would not provide us with the information we hoped to get, since zebra mussels would be stressed by the artificial conditions in the laboratory and may not behave the way they would normally do in a natural body of water. Their fear is that the information we would obtain through laboratory testing could be deceiving. Additionally, such a laboratory system could be very expensive.

System vulnerability. Zebra mussels can enter New York City's water supply system in the following ways. Chelsea pumping station. Zebra mussels are currently working their way east through the Erie Canal. It has been reported that they have been sighted in the Hudson River, just south of Hudson, New York. If they become established, and there's no reason to believe that they won't, they could conceivably foul the intake of the Chelsea pumping station, which is more of the traditional type of intake pipes flowing out to a crib in the center of the Hudson at our Chelsea pumping station.

Senator MOYNIHAN. You actually pump water up?

Mr. CONWAY. We suck water out of the Hudson River and pump it then into our Delaware aqueduct, which conveniently runs right through the property or underneath the property of our pumping station.

Senator MOYNIHAN. So your system is not entirely gravity-fed?

Mr. CONWAY. No. That's one area where we have to pay some money to the Office of Utilities for getting our water to the city. The rest of it, thank God, all arrives by gravity.

However, it is thought that since we chlorinate the Hudson River water at our shaft 6 of the Delaware aqueduct, the chlorine residual being somewhere between 5 and 6 milligrams per liter, it is unlikely that the zebra mussels could survive the trip from the Hudson River to our West Branch reservoir.

Boats. Zebra mussels can attach themselves to the bottom of boats and can be introduced to an uninfested body of water. In their early stages of development, zebra mussels are difficult to see; thus, they may be transported without the knowledge of the transporter. They may live on the bottom of a boat out of water for approximately five days in a dry condition, longer if they are in a dampened portion of the trailer or the boat.

Bait buckets. Fishermen often buy bait, keep it in a bucket of water, and dump the unused bait and water at the end of the day into the body of water in which they are fishing. If there are any zebra mussels or veligers—zebra mussel larvae—in their bait water, they are then introduced into the uninfested body of water.

Birds. It is possible for birds to transport veligers from one body of water to another.

Possible activities that could be taken by our agency to deal with the boating issue are being considered, but they're being considered against the other possible vectors that could bring the veligers into our reservoirs. Some of the things being considered are a ban on all new and returning boats that haven't been stored on the shores of our reservoirs. Second would be to quarantine them for five to 10 days. Another approach might be to require owners to swab all new or returning boats with bleach to effectively kill the zebra mussels before allowing them to be placed into the city's reservoirs.

We also are embarking upon a public relations effort to distribute printed material to fishermen and local bait, tackle, and boat establishments, and we are conducting an educational presentation on zebra mussels to our watershed inspectors, limnologists, and other field staff, who will then be able to check on these mussels while they are in the field.

The Bureau of Water Supply has contracted with Acres International Corporation to conduct a sampling program designed to monitor for zebra mussels within the reservoir system itself. The first samples were taken the week of May 19. The consulting firm will provide all field and laboratory services necessary to successfully conduct this program, which will be performed on a monthly basis from May to October of this year. Acres is an experienced and respected firm. They monitor water bodies for the Empire State Electric Energy Research Corporation, which is the research arm of the New York Power Pool. Last year, ESEERCO selected Acres to conduct the same monitoring program for zebra mussels that we are currently in the process of setting up. The program is briefly described below.

Sampling will begin in May of 1991 and continue on a monthly basis through October. The consultant will conduct a total of six monthly samplings. Sampling will include pump/net sampling to monitor for veligers and substrate sampling for juveniles and adults. The consultant will sample five key locations in the reservoir system. These locations are Ashokan reservoir, Rondout reservoir, Croton Lake, Kensico reservoir, and West Branch reservoir.

The other reservoirs in the city system will be monitored using artificial substrates, which will be placed near the intake of each reservoir. These substrates will be sent to Acres by our agency personnel on a monthly basis. Samples will provide our agency with preliminary results of the laboratory analysis as soon as the samples are analyzed.

Now that the zebra mussels have been definitely sighted in the Hudson River, the urgency of keeping these pests out of the water supply of nine million Americans is clear. Although there is no direct link between the Hudson River and any part of the New York City watershed, the water supply system is at risk. How? It's easy. Recall that boats are often transported between these waters. Fishing bait coming from the Hudson or other zebra mussel-contaminated waters may be sold to people fishing in our reservoirs and their tributaries.

Senator MOYNIHAN. What about the Chelsea pumping station?

Mr. CONWAY. Well, we feel that because of the long distance that would have to be traveled and the heavy chlorination that takes place---

Senator MOYNIHAN. OK. But there is a connection.

Mr. CONWAY. There is that conduit.

Should our watershed system become infested, the damage to New York City's water delivery system will be immense, as these pests will clog water pipes throughout the system. We believe that this is damage that can be avoided with careful monitoring, best management practices, and public cooperation.

We strongly support S. 36, Senator Moynihan's New York City Zebra Mussels Monitoring Act, and we feel that by mobilizing the Army Corps of Engineers to protect our watershed and by providing \$2 million each year for the next five years for this effort, we are certain that the zebra mussel menace—and menace is exactly what these inch-long pests are—will be held at bay. By enacting S. 36, the Federal Government will protect the structural integrity of New York's water supply system, preclude the nearly incalculable expense of remediation after the fact of infestation, and protect every part of the United States from this aquatic invader.

Thank you, Mr. Chairman, and I'll be delighted to answer any questions, with the help of my colleagues.

Senator MOYNIHAN. Thank you, Commissioner.

Dr. Miller, let's have you have the last word here. Tell me what you think you've heard this morning. I was struck by Commissioner Conway's suggestion that the calcium content of the Delaware system is a good barrier.

Mr. MILLER. Yes, I would certainly agree with that. I think it's useful, especially when you have so many reservoir systems, to have that in a sense as a backup.

I'll just conclude with a few brief comments.

Senator MOYNIHAN. And don't leave out the village of Catskill, whose president has been very patient in attending here. They drink water here, too.

[Laughter.]

Mr. MILLER. Right. I've already made a note of that.

I think we should remember that much can be learned from the Canadians and the Europeans. The Canadians are spending literally millions of dollars a year on research, and we just got finished listening to them and their presentations, and I think we've got a lot to learn, and it's useful that they're already on this continent; that is, the Canadians can provide us with this information.

Let's not forget that chlorine was first used in Europe as a molluscicide before it was used to clean water.

Senator MOYNIHAN. Is that right?

Mr. MILLER. That's right.

Senator MOYNIHAN. Give us a date on that.

Mr. MILLER. It was probably right after the Industrial Revolution, I would say.

Senator MOYNIHAN. In 1840, you mean?

Mr. MILLER. Probably.

Senator MOYNIHAN. Well, that's an interesting point, isn't it? And the Canadians are on this continent.

[Laughter.]

Mr. MILLER. In other words, we don't have to go to Europe.

Senator MOYNIHAN. We have a rule on our committee that whenever we're dealing with a subject, you never fail to learn something

if you ask, "What do the Canadians do?" You always learn something.

I had a small resolution last year pass the Senate on S. 312 asking the President to direct the Secretary of State to negotiate with the government of Canada to establish a program of zebra mussel research and control. I don't know if we've done that. Have we?

Mr. MILLER. I'm not aware of it.

Senator MOYNIHAN. We'll find out. But we keep telling the President to do things, and he sometimes does, and he sometimes doesn't.

Mr. MILLER. Certainly, many entities in this country are already working with the Canadians.

Senator MOYNIHAN. Yes.

Mr. MILLER. I think the ballast water question that was brought up is still germane, because there are many more exotics in Europe that could be brought over in ballast water that weren't here---

Senator MOYNIHAN. Don't think that this is the last visitor?

Mr. MILLER. Right. For example, San Francisco Bay has 20 species of mollusks. None of them are indigenous to this country. They've all been brought over from Europe, and they've driven out all of the native mussels.

As far as biological control, let's not forget that there are organisms in this country that do feed on mussels. For example, the fresh water drum, which is common in the Mississippi River, is a molluscivore and does feed on shells. I'm not sure that these are going to be control agents, though they do feed on them, and certainly we don't want to fall into the trap of trying to import another exotic to feed on an exotic that's already here.

Senator MOYNIHAN. We have had some bad experiences with birds and things.

Mr. MILLER. Concerning the reference to the sea lamprey, the chemicals that were developed for the control of the sea lamprey were developed, of course, a few years ago. Today the economic situation is a little different, and I'm not sure that many chemical supply companies are interested in going through the tremendous problem of getting these new compounds listed to be used. The financial gain many times is not there. So I'm not certain that we're going to have a lot of companies looking for new molluscicides to develop and try to sell.

Senator MOYNIHAN. Where does that licensing process go through? The FDA and EPA?

Mr. MILLER. Yes, and it's very rigorous.

Senator MOYNIHAN. You have to say this is all right.

Mr. MILLER. That's right. It has to be approved, and sometimes---

Senator MOYNIHAN. I'm sorry. Not you, sir, but the EPA.

Mr. MILLER. Right.

Sometimes things are tested and retested. We don't have many of the molluscicides and many of the chemical control agents at our disposal that the Europeans have.

Let's also not forget that the zebra mussel is at a very high density right now, and the densities may decrease. Now we are in a situation where the densities here are much greater than they are

in Europe. It's quite possible that this is exploitation of a new habitat. Numbers may decline within 10 years, but this also is a bit of a disadvantage. Let's assume that a water supply becomes infested with zebra mussels, and then the zebra mussels die off rather quickly. Taste and odor problems can result.

The feeding activities of zebra mussels—that is, their ability to remove from the water phytoplankton, bacteria, suspended sediments, and so on—do work to our advantage, and that is the Europeans do use zebra mussels as water clarifiers. But let's not cloud the issue early on. We're not to the stage yet of using zebra mussels for beneficial uses. We're in an attempt to understand these organisms and to control them. I think that it may put some confusion and ambiguity into these early discussions on zebra mussels if we start talking about beneficial uses too early.

I'll reiterate what Colonel Danielson said about the solution to zebra mussels—that is, there is not a magic bullet that we can use to treat our waters with to control zebra mussels. What we need to do is understand the design of various powerplants, water structures, locks and dams, and using this information, we need to head off infestations of zebra mussels, and in some cases we may need to redesign.

For example, the Corps of Engineers is putting locks and dams in the Ohio River division. We need to get right on those designs and ensure that they're not going to be susceptible to zebra mussels, and I'm sure that's true with almost all of our water users along the Nation's waterways. So I think that's one of the areas that the U.S. Army Corps of Engineers can assist in, and that is looking at the design of existing structures to ensure that we can control mussels when they infest.

Thank you.

Senator MOYNIHAN. I thank you.

May I say that we hope that our committee, as this goes on, will be sensitive to science concerns and limits. We obviously don't want to rush into anything, but it could be we handle this better than we've handled other things earlier if we've learned things. We've got an awful lot of water around the United States. We don't have enough in some parts of the world. One thing we're blessed with in the east is we have enough water, and we wouldn't want to have that blessing end up being full of zebra mussels.

[Laughter.]

Senator MOYNIHAN. You seem to be fairly confident you can handle this, Commissioner.

Mr. CONWAY. Well, we think that we have a shot at it, but—

Senator MOYNIHAN. You think you have a shot at it. That doesn't come under the heading of certain.

Mr. CONWAY. No, I wouldn't say we are certain because of a lot of things that are happening in the American waters that didn't happen in the European waters. For instance, the movement of them is much greater. We're continuously being surprised at how quickly they're able to get from one location to another, how rapidly they're multiplying, which is quite different from there.

Senator MOYNIHAN. I think that may be the note on which to conclude this hearing. You've got the Corps of Engineers on your side, which is something powerful going for you. You have a very

vigorous environmental protection agency, and if they're tough about what they approve, it's because they know what they're doing. But to say that you have a shot at it I think about sums up the situation and suggests that we better stay alert to this and get on top of it and get our legislation moving.

Colonel Danielson, would you like to have a closing word for us?

Colonel DANIELSON. I guess we are certainly ready to serve in any capacity that we're asked to. As we've outlined and as Dr. Miller has outlined, we have begun the process of trying to understand this organism and how it's going to impact the operating facilities. Our focus, perhaps primarily now, is on the types of facilities that we're most familiar with, locks and dams, but we're also expanding that research and going to make it available to everybody on all types of water-related facilities that this organism could impact on. As I said, we are prepared to serve where asked.

Senator MOYNIHAN. Well, that's an old habit of the Corps of Engineers, and I don't mean in any way to be critical, but it is not possible to be on this committee for the last decade without noting that in most of the years in the 1980's, the Corps of Engineers carried out more construction in Saudi Arabia than it did in the United States. Now, that's Congress' fault, not yours.

With that, I want to once again thank President McCord for his great courtesy and thank the village and the village officials here. As we noted, they drink water in Catskill also, and we won't forget where we held this hearing.

Mr. McCORD. Senator, you're always welcome here, and we're very happy you decided to use our fair village for your hearing.

Senator MOYNIHAN. You're very kind to say that, sir.

With that, thanking our recorder, Mr. Jinks, and thanking Dan French, who does all the work on these affairs, we will then adjourn.

[Whereupon, at 12:24 p.m., the subcommittee adjourned, to reconvene at the call of the Chair.]

[Statements submitted for the record and the bill, S. 36, follow:]

**STATEMENT OF
GILMAN D. VEITH
DIRECTOR, ENVIRONMENTAL RESEARCH LABORATORY-DULUTH
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
BEFORE THE
SUBCOMMITTEE ON WATER RESOURCES, TRANSPORTATION,
AND INFRASTRUCTURE
OF THE
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE**

**May 31, 1991
Catskill, NY**

Good morning Mr. Chairman and Members of the Subcommittee. I am Gilman Veith, Director of the Duluth, Minnesota Environmental Research Laboratory of the U.S. Environmental Protection Agency (EPA), Office of Research and Development. I appreciate the opportunity to discuss the impacts of nonindigenous aquatic nuisance species on aquatic ecosystems of the coastal and inland waters of the United States.

EPA is an active participant on the Aquatic Nuisance Species Task Force (formed under the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990). This Task Force is developing a multi-agency program for the monitoring, control and study of aquatic nuisance species, including zebra mussels. EPA shares the concern over the immediate economic impacts on our public infrastructure and on our fisheries; however, we will give our highest priority to the long-term impact on the health and sustainability of aquatic ecosystems.

EPA has initiated the Environmental Monitoring and Assessment Program (EMAP) to monitor ecological status and trends within our ecological resources, including estuaries, lakes, streams, and wetlands. One of the primary goals of EMAP

- 2 -

will be to guide environmental policy using objective data with respect to the extent and rate at which specific resources are degrading. Because the determination of biological integrity for our aquatic systems is an important measure of ecosystem health, it is reasonable to use EMAP to assess long-term status and trends of nuisance populations, not only to judge the seriousness of individual infestations, but also to judge the effectiveness of prescribed control programs. I believe the EMAP sampling frame could accommodate the monitoring for zebra mussels.

In FY 91, the EPA Assistant Administrator for the Office of Research and Development supported an international workshop specifically on the zebra mussel issue in fresh water. This workshop provided a public forum for scientists from government, universities, and industry to present early results of investigations concerning zebra mussels in aquatic ecosystems.

I am providing for the record a copy of our workshop proceedings entitled "Ecology and Management of the Zebra Mussel and other Introduced Aquatic Nuisance Species." The findings offer recommendations for retarding the rate of spread of the zebra mussel through public education and management of the transfer vectors. In addition, the findings may offer possible control options for the New York water supply should the zebra mussel become established in the reservoir system. The addition of chlorine at the water intake has proven successful in protecting systems on the Great Lakes that had been clogged early in the zebra mussel infestation.

- 3 -

EPA is conducting research on two major areas. First, we are determining the long-term impacts on the integrity of aquatic ecosystems resulting from zebra mussel infestations. This research should be applicable to forecasting the time and course of infestation in one of the New York reservoirs or lakes should zebra mussels become established. Second, we are evaluating the environmental safety of chemicals used to control zebra mussels to guide such programs in the development of sound control methods. The results of these studies will be made available to the State of New York as soon as they are complete.

While we are aggressively searching for methods to minimize the impacts of zebra mussels, EPA supports a strong prevention effort to minimize the possibility of introducing the zebra mussel to the New York water supply system.

This concludes my prepared statement; I would be pleased to respond to questions you may have at this time.

TESTIMONY PRESENTED TO:
U.S. SENATE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
SUBCOMMITTEE ON WATER RESOURCES, TRANSPORTATION,
AND INFRASTRUCTURE

Presented by:
Charles R. O'Neill, Jr.
Coastal Resources Specialist
New York Sea Grant Extension Program
31 May 1991

On behalf of New York Sea Grant, I wish to thank the Committee for the opportunity to speak before you this morning. New York Sea Grant, a university-based marine and coastal research and education program of the State University of New York and Cornell University, has been involved in public information, education, and research efforts pertaining to *Dreissena polymorpha*, commonly referred to as the zebra mussel, since October 1988. Sea Grant has paid particular attention to public and private infrastructure impacts and control technologies.

Since the first sighting of the zebra mussel in New York, October 1989 in the Niagara Mohawk Power Corporation's Dunkirk Steam Station, the mussels quickly expanded their range throughout the state's Great Lakes waters and their connecting waterways. By the end of December 1989, the zebra mussel had colonized all of New York's Lake Erie shoreline and several mussels were found on the bottom of a navigational buoy four miles off the Niagara bar in western Lake Ontario.

During 1990, the mussels spread along the entire south shore of Lake Ontario, infesting the water intakes of most public drinking water treatment facilities and all power plants which draw water from that lake, including the Rochester Gas & Electric Ginna Nuclear Power Plant, the Nine Mile Point nuclear complex, and the New York Power Authority's Fitzpatrick Nuclear Power Plant. The mussels had also arrived in the mouth of the St. Lawrence River near Cape Vincent and colonized the St. Lawrence Seaway Eisenhower and Snell Locks in Massena and the Erie Canal from Buffalo east to Palmyra, some 20 miles east of Rochester.

At the beginning of 1991, New York Sea Grant was ready to track the mussel's range expansion into other New York waters. Infestations are expected in at least several of the Finger Lakes, Chautauqua Lake, the eastern reaches of the Erie Canal and the Mohawk River, perhaps as far east as the Hudson River at Troy, as the mussel began its inexorable march inland. The "zebra mussel season" begins with the first evidence of spawning activity. We were surprised this Spring when mussel veligers were confirmed in Lake Ontario near New York State Electric and Gas's Somerset Station in Niagara County on April 14th. These veligers, found in 7°C water, made their appearance far earlier and in far colder water than expected. By early May, veligers were also being found in the lake's central and eastern basins.

The zebra mussel is expected to expand its range in a number of ways. Natural vectors such as lake and river currents and attachment to the feet, legs and feathers of shore birds and to the shells of turtles and crayfish are expected to play a role in the dispersal of the mussel. Human-related dispersal vectors,

however, will most likely play the most significant role in the spread of the zebra mussel. Juvenile and adult mussels attached to boat hulls, engine stern drive units, and even boat trailers can live several days out of water if they are not in direct sunlight. Kept moist (as they would be in bilge, live wells, and trailer frame channels) mussels could survive out of water for up to a week. Every time an angler adds water to a bait bucket in infested waters, the possibility exists that mussel larvae will be added. The importance of navigation and irrigation canals, attachment to commercial and recreational boat hulls, the inadvertent transport in commercial shipping ballast tanks, motorboat bilges, bait buckets, and engine cooling water (both on trailered and in the water boats), as well as the potential intentional release of mussels into previously uninfested waterbodies should not be underestimated.

Researchers from Cornell University confirmed zebra mussels growing on freshwater clam shells in the eastern end of Oneida Lake on May 6th. This discovery was several months earlier than originally expected. Although the lake is an integral part of the Erie Canal system, it is not known whether the mussels were introduced into the lake via natural canal flow; via boats traveling through the canal; or via boats trailered to the lake from infested waters.

On or about May 19, 1991, a commercial fisherman fishing for sturgeon on the Hudson River found striped mussels attached to freshwater clam shells in the vicinity of the Rip Van Winkle Bridge near Catskill, New York. The suspected zebra mussels were sent to Cornell University's Biological Field Station where a

preliminary identification as zebra mussels was made on May 21st by Dr. Edward Mills, an aquatic biologist. This identification was corroborated on May 22nd by Sea Grant biologist David MacNeill, and confirmed on May 23rd by Dr. James Carlton, director of the Maritime Studies Program of Williams College in Mystic Seaport, Connecticut, who is an internationally recognized expert on marine exotic organism introductions.

Zebra mussel experts approached the identification of these mussels with caution because the native brackish water "dark false mussel" (*Mytilopsis leucophaeta*) was mistakenly identified as the zebra mussel (*Dreissena polymorpha*) last November in the lower Hudson near Croton Point. Since then, additional zebra mussels have been pulled from the Hudson River by the same fisherman attached to more clam shells, rocks, and driftwood in waters between 10 and 50 feet deep both up- and downstream from the Rip Van Winkle Bridge (between river miles 112 and 115). While the actual transmittal vector in this case is not known, the mussels could have been introduced into the river by direct transport through the Erie Canal, on a boat trailered to the Hudson from infested waters, or discharged directly into the river in freshwater ballast from an international commercial ship traveling upriver to the Port of Albany.

The sighting in the Hudson River is the eastern-most occurrence of the mussel in New York and was not unexpected. It did, however, occur much earlier than expected. The sighting is also significant in that it is the first confirmed sighting of the mussel in the United States outside of the Great Lakes drainage basin. Until now, all occurrences of the zebra mussel

have been within the portion of North America that drains into the Great Lakes. With the mussel now in the Hudson and poised to enter the Mississippi River drainage system south of Chicago, the "genie is out of the bottle."

Effects of the mussel's spread throughout New York's inland waters will be felt by almost all surface water users: fishery managers, anglers, boaters, commercial navigation, and shoreline recreators, as well as raw water users such as electric power generators, industries, and public water treatment facilities. Zebra mussels are already fouling raw water intakes at electric power generation and public water supply filtration facilities throughout New York's Great Lakes coast, reducing intake head; clogging heat exchangers; and entering cooling, lubricating, air conditioning, and fire fighting service and distribution water lines.

New York Sea Grant has estimated that the cost of controlling the mussel's impacts on New York water treatment and power generation facilities alone, in both Great Lakes and inland locations, may total more than \$500 million over the next ten years. No fresh surface water user - not the smallest "mom & pop" campground treating its own water drawn from the St. Lawrence River; not a cottage owner using Canandaigua Lake for camp water; not the City of New York with its vast upland reservoir system - can be assumed to be immune to the zebra mussel and its impacts.

New York State's response to the zebra mussel needs to be a coordinated, multidisciplinary combination of monitoring, research, and education in coordination with similar federal

activities. State plans for dealing with the mussel's impacts on both public and private infrastructure should be prepared immediately as provided for under the 1990 Nonindigenous Aquatic Nuisance Act.

New York Sea Grant and its Zebra Mussel Information Clearinghouse project stand ready to assist the state and federal governments by undertaking research into the impacts and control of the mussel and by providing all impacted water users with the most up-to-date information available, coordinating monitoring activities, and serving as the linchpin for public information and education programs related to the mussel's spread, impacts, and control measures.

Once again, I thank the Committee for this opportunity to address the zebra mussel situation.

COMPLETE STATEMENT

OF

COLONEL R. M. DANIELSON

DISTRICT COMMANDER

U.S. ARMY ENGINEER DISTRICT, NEW YORK

ON

ZEBRA MUSSEL INFESTATION OF THE HUDSON RIVER

PRESENTED TO THE

SUBCOMMITTEE ON

WATER RESOURCES, TRANSPORTATION, AND INFRASTRUCTURE

OF THE

SENATE ENVIRONMENT AND PUBLIC WORKS COMMITTEE

CATSKILL, NEW YORK

MAY 31, 1991

Mr. Chairman, I am pleased to be here today to represent the Secretary of the Army in this discussion of the zebra mussel and its impact on our water resource infrastructure, particularly here in New York. Accompanying me is Dr. Andrew Miller, a research limnologist at the Army Corps of Engineers, Waterways Experiment Station in Vicksburg, Mississippi. Dr. Miller is the senior scientist responsible for the research efforts of the Corps of Engineers related to the zebra mussel.

In my statement, I will address the zebra mussel problem in general, what we in the Army Corps of Engineers are doing about this problem, what our plans are for future efforts, and what we could be doing to assist in managing the Hudson River infestation.

The zebra mussel, scientific name Dreissena polymorpha, is a European species which was first reported in the United States in 1986. In that year, it was accidentally introduced into Lake St. Clair by the release of ballast water from ocean vessels arriving from northern Europe. The subsequent spread of the species to other sites in the Great Lakes has been rapid and the results severe. Zebra mussels are small organisms, about a half-inch long, but encrustations formed by multitudes of this species are likely to negatively impact locks and dams, hulls of recreational and commercial vessels, cooling plants in dredges and tugboats, navigation buoys, and nets of commercial fishermen that remain in the water for long periods of time. But perhaps most significantly, this organism can adversely affect public equipment and facilities associated with municipal water supplies. By their numbers, they can obstruct the flow of water through pipes and interfere in the operation of mechanical equipment. Congress has reported that this species could spread throughout two-thirds of the United States and cause \$5 billion in damage by the year 2000.

There are some characteristics of zebra mussels that make them particularly noxious. Unlike native mussels, which are found on, or slightly beneath the surface of sand or gravel shoals in rivers and lakes, this species has a stout byssus, or holdfast, which enables it to tenaciously attach to fairly smooth structures such as steel or concrete. Their immature stage is free-swimming, and as adults, they can attach themselves to driftwood, the hulls of boats and barges, or the surfaces of other objects in the water. Immature and adult stages can thus be transported over scores of river miles. Recreational boaters hauling their crafts from one waterbody to another could potentially be carrying zebra mussels in some moist crevice in their boat or trailer. In this way, the species can move from one drainage basin to another and eventually spread throughout most of the freshwater in the United States. Zebra mussels tolerate extreme crowding, up to 750,000 individuals per square

meter. They are restricted to freshwater or very slightly brackish water, and so are found in rivers and lakes.

Because of the likelihood that zebra mussels will become a serious invasive pest at locks and dams, water supply systems, and other public facilities, the Corps of Engineers is making every effort to investigate species-specific control methods and procedures. A comprehensive program involves coordination with Federal, state, and local government agencies and academic personnel and is based on biological, ecological and physiological information. Ongoing studies by the Corps and others on large waterways will be integral components of the program.

The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, PL 101-646, established the Aquatic Nuisance Species Task Force. Under the law, the Task Force is directed to develop and implement a program for waters of the United States to prevent introduction and dispersal of aquatic nuisance species; to monitor, control and study such species, and to disseminate related information. The membership in the Task Force consists of the Director of the U.S. Fish and Wildlife Service, the Under Secretary of Commerce for Oceans and Atmosphere, the Administrator of the Environmental Protection Agency, the Commandant of the Coast Guard, and the Assistant Secretary of the Army (Civil Works). This Task Force will also be responsible for preparation of the Aquatic Nuisance Species Report to Congress required by the legislation. In addition, the law directed the Army in consultation with the Task Force to create a program of research and technology development for the environmentally sound control of zebra mussels in and around public facilities. The Assistant Secretary has tasked the U.S. Army Corps of Engineers with developing this program. Information that we gather from this effort will be made available to Federal, State, and local water managers in the forms of workshops, meetings, Government reports, and scientific papers.

In response to the directive to develop a research program for the control of the zebra mussel, the Corps of Engineers, through its Waterways Experiment Station, has undertaken the following activities during 1991:

1. Identification of points of contact in the Corps, U.S. Fish and Wildlife Service, other Federal and state agencies, and academia;
2. Consolidation of existing information on zebra mussels from literature and conferences;
3. Initiation of preliminary studies on potential control methods with the Center for Biological Macrofouling Research;
4. Development of a four-year research and development plan including ongoing technology transfer; and,
5. Hosting of an interagency workshop on 29-30 May to

discuss techniques for controlling zebra mussels.

The objective of this research program is to investigate techniques for controlling zebra mussels at public facilities. From experiences in Europe and the Great Lakes, it is known that zebra mussels can reduce the efficiency of locks, cooling plants of commercial navigation vessels, water intakes, pumps and other machinery associated with large and small public projects. The effect on public water supply facilities is also of major concern. The research program will consist of the following components:

1. Management and information transfer. There is already some information about the zebra mussel in the scientific literature of Canada and Europe, as European industry has been living with this pest for years. We will be looking at the best ways to transfer this information, together with what we learn with our own research, to water managers.
2. Environmental effects of zebra mussel introduction and colonization. In rivers and lakes we will be studying the effects of zebra mussels infestations on water and sediment quality, native mussels and other invertebrates, and fish spawning sites.
3. Control methods. We will look at specific methods to reduce the population of zebra mussels at a site and limit their infestation. We will apply the results of research on desiccation, thermal tolerance, and byssal thread characteristics.
4. Stress. We will examine the biochemical and organismal stress indicators. These are things like chemical balances within the body, tissue condition, and oxygen consumption. Better understanding of the mussel's physiology will permit us to analyze the effects of various control methods.

The research program has been designed to focus on zebra mussels at public facilities. Attention will be directed to the efficacy of suggested techniques (application of molluscicides, toxic or nontoxic coatings, and physical methods such as desiccation and thermal stress), and the environmental effects of these techniques or materials.

Although the U.S. Fish and Wildlife Service has the mandate for monitoring the spread of zebra mussels in the United States, the Corps Waterways Experiment Station will conduct limited studies on the distribution of this pest as part of its research program. During the current month, May 1991, the Waterways Experiment Station has contracted with LTRM Laboratory on the Illinois River to regularly sample water and sediments for immature and adult zebras mussel. In addition, the laboratory will analyze commercially available compounds that, when applied to concrete or steel surfaces, may repel zebra mussels. The Waterways Experiment Station will fund additional laboratories to

monitor for zebra mussels in 1992. We anticipate that one laboratory will be on the upper Ohio River, one on the upper Mississippi River, and one on the Hudson River. With the other Federal members of the Aquatic Nuisance Species Task Force, the Army Corps of Engineers will continually transfer the knowledge gained from these efforts to State and local governments.

The appearance of the zebra mussel in the Hudson River is not surprising, and there is little that could practically have been done to prevent it. This pest species was known to exist in 1990 in the New York State Barge Canal system. A colony is established in the Erie Canal section at Palmyra, New York, approximately 20 miles east of Rochester. In addition, zebra mussels have been found attached to native mussel shells in Lake Oneida, just northeast of Syracuse. The Barge Canal runs through Lake Oneida before entering the Mohawk River, which empties into the Hudson River just north of Albany. The planktonic larval stage of the zebra mussel enhances the rapid downstream spread of this species once it is established in a drainage system. We believe that the zebra mussel is in the Hudson River to stay, and given its ability to hitchhike on commercial and recreational vessels, we will see it turning up in other drainage basins in the country before too long.

The presence of the zebra mussel in United States waters is rightfully generating considerable concern. Where present, this organism has greatly reduced the efficiency of municipal and industrial water supply systems and water control structures. Also, as with the introduction of other exotic species, native plant and animal populations and communities have been altered. However, we must realize that the zebra mussel is here to stay. We are not going to be able to vaccinate our rivers and lakes to prevent the spread of this pest. We will be able to eradicate it temporarily in some areas, and we can slow its growth in some places, but mainly, we are going to have to live with the zebra mussel. We are going to have to change some of our maintenance practices and replace some of our equipment to deal with this problem.

I want to point out that this is not an overwhelming situation. After all, the Europeans have been living with this pest for years, and have managed. There are control methods available. For example, facilities in Europe often operate twin water intake structures so that one can be shut down for cleaning while still operating the other. Power plants have been designed to permit steam to be injected into the pipes to kill the mussels that have attached there. We believe that results of our research will provide additional options for Federal, state, and local water managers to consider.

We are looking at the full potential geographic range of the zebra mussel, but of course, New York City and the communities in

this area will benefit from our findings. Specifically for this area, the New York District of the Army Corps of Engineers can offer technical assistance on the New York City water supply system either through the Planning Assistance to States Program authorized by section 22 of the Water Resources Development Act of 1974, or as direct reimbursable services authorized by the Intergovernmental Cooperation Act and section 922 of the Water Resources Development Act of 1986.

Mr. Chairman, that concludes my statement. Dr. Miller and I are available to answer any questions you may have.

TESTIMONY OF JOSEPH P. CONWAY

ON

ZEBRA MUSSELS AND THEIR POTENTIAL IMPACT

ON THE NEW YORK CITY WATER SUPPLY SYSTEM

PRESENTED TO THE

SUBCOMMITTEE ON

WATER RESOURCES, TRANSPORTATION, AND INFRASTRUCTURE

OF THE

SENATE ENVIRONMENT AND PUBLIC WORKS COMMITTEE

CATSKILL, NEW YORK

MAY 31, 1991

Testimony of Assistant Commissioner Joseph P. Conway
S. 36 New York City Zebra Mussel Monitoring Act
May 31, 1991

Good morning, my name is Joseph Conway. I'm the Director of New York City's Water Supply System. I thank you for the invitation to testify this morning and fully support Senate Bill 36.

Let me give you an overview of how the Zebra Mussel problem will impact New York City's Water Supply System.

The Problem

The concern is that zebra mussels could enter the New York City water supply reservoir system and cause disruption by multiplying in, and thereby clogging, water tunnels. Zebra mussels often cluster around water intake pipes, which provide a moving source of food. Each female can produce between 30,000 and 40,000 offspring per year. Older females have been found to produce up to 1,000,000 offspring per year. Once zebra mussels have entered a water supply, it is very difficult to effectively get rid of them. Most water suppliers use chlorine to kill zebra mussels, although this can result in elevated levels of trihalomethanes. Other methods (such as the use of ozone, potassium permanganate, biocides, high frequency sounds, electrical shocks, heat, etc.) for tackling the zebra mussel problem for water suppliers are currently being researched.

Limiting Factors

The most significant limiting factors are water temperature and calcium concentrations.

Temperature - Zebra mussel spawning generally begins when water temperature reaches 12 degrees C or 54 degrees F. Optimum spawning occurs between 18-21 degrees C or 72 degrees F. Below 54 degrees F little activity takes place.

Calcium - Zebra mussels become stressed if the calcium concentration in a body of water is as low as 10 - 12 mg/l. There is no maximum concentration of calcium, since calcium uptake is related to shell formation.

Other limiting factors include:

Water Currents - Optimum water currents are 0.15 to 0.50 meters/second for proper growth.

Hard Substrate - The zebra mussels must have a hard surface they can latch on to (such as dock pilings, pipes, etc.). However, they are very adaptable, and can even latch onto clam shells.

Food Source - Zebra mussels need sufficient phytoplankton or bacteria as their food source.

New York City Water Supply and Limiting Factors

An analysis of the New York City reservoirs shows that our reservoirs achieve temperatures conducive to reproduction of zebra mussels during May through October. The water temperatures appear to be too cold for spawning during the rest of the year.

In the East-of-Hudson System, the concentration of calcium in Kensico reservoir (mean 3.73 - 5.87mg/l), West Branch reservoir (mean 6.53 - 8.64mg/l), and Lake Gilead (mean 9.14 - 11.21mg/l) is low enough so that it is unlikely that zebra mussels could survive and reproduce. However, all of the other reservoirs and controlled lakes in the Croton System have calcium concentrations that appear high enough for zebra mussels to exist (the mean is anywhere from 12.64 to 23.28mg/l in each reservoir).

The Catskill/Delaware system reservoirs have calcium concentrations lower than 10mg/l (generally 3 to 8mg/l), thus it would appear that zebra mussels could not survive and reproduce in these waters. In comparison with our water supply reservoirs, the Great Lakes, which are being overrun by zebra mussels, have calcium concentrations as high as 180 mg/l.

It has been pointed out that the 10mg/l limit has been derived from the European literature. Although there is nothing in the experience of utilities in the United States that has shown that zebra mussels can survive in waters having lower concentrations of calcium, this cannot be stated for certain. The American experience with zebra mussels is relatively new, since they were first discovered in the United States in Lake St. Claire in June 1988.

It was decided that some of our reservoir water be tested to see if it permits zebra mussel survival and reproduction. This suggestion was brought to the attention of Acres International Corporation, specialists in the field. Acres stated that such an experiment probably would not provide us with the information we hoped to get, since the zebra mussels would be stressed by the artificial conditions in the laboratory, and may not behave the way

they normally would in a natural body of water. Their fear is that the information we would obtain could be deceiving. Additionally, such a study would be very expensive.

System Vulnerability

Zebra mussels can enter New York City's water supply system in the following ways:

1. Chelsea Pumping Station - Zebra mussels are currently working their way east through the Erie Canal. It has just been reported that they have been sighted in the Hudson River, just south of Hudson, N.Y. (N.Y. Times, May 26, 1991). If they become established in the Hudson, they could conceivably foul the intake of the Chelsea Pumping Station. However, it is thought that since we chlorinate the Hudson River water (at shaft 6 at Chelsea, the chlorine residual is 5-6 mg/l), it is unlikely that zebra mussels could survive the trip from the Hudson to the West Branch Reservoir.

2. Boats - Zebra mussels can attach themselves to the bottoms of boats, and can then be introduced to an uninfested body of water. In their early stages of development, zebra mussels are difficult to see, thus, they may be transported without the knowledge of the transporter. They may live on the bottom of a boat out of water for approximately five days.

3. Bait Buckets - Fishermen often buy bait, keep it in a bucket of water, and dump the unused bait and water at the end of the day into the body of water in which they are fishing. If there are any zebra mussels or veligers (zebra mussel larvae) in their bait water, they are then introduced into the uninfested body of water.

4. Birds - It is possible for birds to transport veligers from one body of water to another.

Preventive Measures Regarding Boats and Bait

There was discussion regarding the best mechanism for advising people of the dangers of placing zebra mussel contaminated boats and bait in our reservoirs. We expressed our serious reservations about mounting any wide-spread publicity campaign of this nature. We feel that such a campaign would be counter-productive in that it would serve to inform the public at large (including many who don't and would never normally use our reservoirs) of this serious vulnerability problem. We feel that any educational program in this area must be focused on only those who use our waters for boating and fishing.

Fishermen will be targeted in our zebra mussel educational program. NYSDEC requires fishermen to obtain fishing licenses each year they fish in New York State. NYSDEC requires fishermen to obtain permits for fishing in our reservoirs; however, it is only necessary to obtain this permit once in a fisherman's lifetime. Boaters in our reservoirs are required to obtain annual boating permits by NYCDEF. Ideally, all fishermen and boaters permitted in the New York City reservoir system will receive fact sheets about the zebra mussel at the time they receive their permits. A request must be made to NYSDEC for them to provide zebra mussel fact sheets along with their fishing permits.

Possible activities that could be undertaken by our agency with regard to zebra mussel prevention include the following:

1. Ban all new and returning boats. This would require an emergency declaration by the Commissioner and must be preceded by legal research. It could be limited to Croton Reservoirs. It would be extremely unpopular with fishermen and fishery-related entrepreneurs. But with the right public relations, this could be acceptable to the general public.

2. Quarantine all new/returning boats for five to ten days to assure desiccation of the mussels. There are considerations of manpower, liability for vandalism and lack of secure storage space, especially in East of Hudson.

3. Another stringent measure would be to require that owners swab all new/returning boats with bleach to effectively kill the zebra mussels, if that is a viable technique. Who, where, how are not easy to determine given the backlog of maintenance projects and the lack of resources.

4. Public relations efforts: Distribute printed material to fishermen and local bait/tackle/boat establishments.

In addition, we feel it would be useful to educate fishermen through the local chapters of their fishing organizations, such as Trout Unlimited, about the problems associated with zebra mussels, and preventive measures they could take against introducing these mussels to the New York City reservoir system.

Consideration should also be given to drafting legislation which would prohibit bait shops in New York State from selling bait that was obtained from a body of water known to contain zebra mussels.

We will be conducting an educational presentation on zebra mussels to watershed inspectors, limnologists, and other field staff, who will then be able to check for these mussels while they are in the field.

Complete control in this area is difficult, if not impossible. Presently, boating and fishing takes place in all of our reservoirs and controlled lakes (18 reservoirs and 3 controlled lakes). These water bodies include over 400 miles of shore line. It is estimated that there are over 4,000 boats permanently stationed in our system, and another 500 are transported in seasonally. There are not enough watershed inspectors to police this area to prevent boats from entering the reservoirs. However, if resources could be increased, more inspectors could be hired to inspect new boats entering our reservoirs. In addition, there are approximately 25 private lakes in the watershed where boating (including power boating) takes place with no DEP permitting or contact.

Zebra Mussel Monitoring Program

The Bureau of Water Supply has contracted with Acres International Corporation, to conduct a sampling program designed to monitor for zebra mussels in the New York City reservoir system. The first samples were taken the week of May 19th. The consulting firm will provide all field and laboratory services necessary to successfully conduct this program, which will be performed on a monthly basis from May through October 1991.

Acres is an experienced and respected firm. They monitor water bodies for the Empire State Electric Energy Research Corporation (ESEERCO), which is the research arm of the New York Power Pool. Last year, ESEERCO selected Acres to conduct the same monitoring program for zebra mussels that we are currently in the process of setting up.

The sampling program is briefly described below:

Sampling will begin in May 1991 and continue on a monthly basis through October 1991. The consultant will conduct a total of six monthly samplings. Sampling will include pump/net sampling to monitor for veligers and substrate sampling for juveniles and adults.

The consultant will sample five key locations in the reservoir system. These locations are:

- (a) Ashokan Reservoir
- (b) Rondout Reservoir
- (c) Croton Lake
- (d) Kensico Reservoir and
- (e) West Branch Reservoir

The other reservoirs in the New York City water supply system will be monitored using artificial substrates, which will be placed

near the intake. These substrates will be sent to Acres by DEP personnel on a monthly basis. Samples will be analyzed in the laboratory using standard practices developed for ESEERCO and other zebra mussel sampling programs. Acres will provide NYCDEP with preliminary results of the laboratory analysis as soon as samples are analyzed. Attached find a detailed description of the zebra mussel monitoring program formulated by DEP and Acres International.

New Developments in the Study of Zebra Mussels

NYCDEP is a member of the New York Zebra Mussel Information Clearinghouse, which is part of the New York Sea Grant Extension. The Bureau of Water Supply receives their newsletter, which includes information regarding research being conducted to combat the zebra mussel problem in this country. We recently contacted the Clearinghouse and obtained the most recent case histories and reports they have of water suppliers who have taken steps to prevent and/or control zebra mussels within their water supply system.

Now that zebra mussels have been definitively sighted in the Hudson River, the urgency of keeping these pests out of the water supply of nine million Americans is clear. Although there is no direct link between the Hudson River and any part of the New York City watershed, the water supply system is at risk. How? It's easy. Recall that boats are often transported between these waters. Fishing bait coming from the Hudson or other zebra mussel contaminated waters may be sold to people fishing in our reservoirs and their tributaries. Should our watershed become infested, the damage to New York City's water delivery system will be immense as these pests clog water pipes.

We believe that this is damage that can be avoided with careful monitoring, best management practices and public cooperation. We strongly support S. 36, Senator Moynihan's New York City Zebra Mussel Monitoring Act. By mobilizing the Army Corps of Engineers to protect our watershed and by providing \$2,000,000 every year for five years for this effort, we are certain that the zebra mussel menace, and menace is exactly what these inch long pests are, will be held at bay. By enacting S. 36 the federal government will protect the structural integrity of New York City's water supply system, preclude the nearly incalculable expense of remediation after the fact of infestation, and protect every part of the United States from this aquatic invader.

Thank you Mr. Chairman for this opportunity to testify. I will now try to answer any questions regarding this issue.

102D CONGRESS
1ST SESSION

S. 36

Entitled the "New York City Zebra Mussel Monitoring Act of 1991".

IN THE SENATE OF THE UNITED STATES

JANUARY 14 (legislative day, JANUARY 3), 1991

Mr. MOYNIHAN introduced the following bill; which was read twice and referred to the Committee on Environment and Public Works

A BILL

Entitled the "New York City Zebra Mussel Monitoring Act of 1991".

1 *Be it enacted by the Senate and House of Representa-*
2 *tives of the United States of America in Congress assembled,*

3 **SECTION 101. SHORT TITLE.**

4 This title may be cited as the "New York City Zebra
5 Mussel Monitoring Act".

6 **SEC. 102. DEFINITIONS.**

7 For the purposes of this Act:

8 (a) The term "Secretary" means the Assistant
9 Secretary of the Army for Civil Works.

10 (b) The term "Administrator" means the Administrator
11 of the Environmental Protection Agency.

1 (c) The term "Zebra Mussel" means the species Dreis-
2 sena polymorpha.

3 **SEC. 103. FINDINGS.**

4 The Congress finds that—

5 (1) New York City has operated a public water
6 supply system since the late 1700's;

7 (2) the current water supply system supplies over
8 95 per centum of all water used in New York City,
9 providing service to millions of residents;

10 (3) the water supply system obtains its water from
11 three upstate reservoir systems: the Croton, Catskill,
12 and Delaware systems, which include eighteen reser-
13 voirs and three controlled lakes;

14 (4) it is likely that within the coming two decades,
15 the zebra mussel will have infested the entire surface
16 water system of the United States and Canada and
17 that this migration is irreversible and cannot be quar-
18 antined; and

19 (5) introduction of the zebra mussel into the New
20 York City water supply system poses a unique public
21 health threat to millions of citizens.

22 **SEC. 104. PURPOSE.**

23 The purpose of this Act is to establish a program of
24 monitoring and technological development to prevent the in-